# Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY McGRAW PUBLISHING COMPANY, INC.

Volume 72 NEW YORK, SATURDAY, DECEMBER 4, 1915 Number 23

## Proportioning of Fine Aggregate

THE intensive study being devoted to the constitution of concrete augurs well for its future quality. Necessarily in such a subject investigations are fully warranted even though their immediate practical application is doubtful. They may develop new theories, which after further research will result in radical changes in materials, proportions or methods. The very careful and interesting studies made by Professor McNeilly, of Vanderbilt University, published in the last issue of the Engineering Record, seem at present at least to have chiefly a theoretical value. In other words, it seems to be doubtful whether the type of fine aggregate which he found to give such good results is commercially feasible. Possibly there will be conditions which would justify the necessary expense. His researches, however, have a larger value, in helping us to get closer to the real constitution of one our most important engineering materials.

## Ramps Instead of Stairways

INDUSTRIAL engineers will find in the article on the Victor Building in last week's issue, page 656, food for thought on the entrance and exit facilities of factory buildings. The designers of this structure have discarded both stairways and elevators under the conviction that ramps insure greater safety in case the building must be emptied hurriedly. While ramps are a rather common expedient in public buildings, such as railway stations and theaters, their use as the sole means of communication from floor to floor in a high building is believed to be novel in the Victor plant. Their adoption is in harmony with the policy of the Victor Talking Machine Company to do the utmost feasible for the safety of its employees. Apparently there is nothing to interfere with the success of the adopted plan. It seems logical to assume that the capacity per foot width would be greater than that of a stairway. Actual experience with the construction will be of great interest to industrial-plant designers.

## Columns as Ventilating Ducts

IN ONE other respect the article on the Victor Building merits special consideration from the industrial engineer. Hollow cast-iron columns of large diameter have been used and serve not only for supporting loads but also as ventilating ducts. This design involves a number of interesting economic problems. Normally one would expect to use reinforced-concrete columns in a structure of this type. Then comes the question as to the economy of the design used compared with concrete columns and separate heating and ventilating flues. But the question cannot be decided on such simple lines, for floor space was an important factor. Even if the cost of the alternative design would have been the same as that used, floor saving would probably have thrown the balance in favor of the design adopted. Certainly with a similar set of conditions—and they are not extraordinary—the design adopted merits more than passing consideration.

## Why Not Pebbles?

WHEN authorities disagree, there is perhaps excuse for wide differences in individual interpretation of the meaning of a particular term. Since dictionaries are not entirely in accord, it is not surprising that the individual misinterprets the meaning of "gravel," from the standpoint of its necessary requirements for concrete aggregate. This fact is often responsible for the use of bank-run material, as there are definitions for gravel which describe it as "small stones or pebbles, or a mixture of sand and small stones." There is no definite differentiation between cobblestones and boulders, as regards minimum and maximum limits of size. Bank-run deposits may contain particles large enough to fall within the common conception of either, to say nothing of the presence of foreign matter, such as clay and loam, that render the material unfit for concrete aggregate. Why not use a term that would suggest a clean material as well as one consisting of particles fairly well limited as regards minimum and maximum size? Pebbles, in the minds of most people, are clean, rock particles made so by attrition in streams or otherwise. If "pebbles", ranging from a certain minimum to maximum, were specified as coarse aggregate, such specification would immediately carry the idea of cleanliness and freedom from particles below and above a certain minimum and maximum. As such material cannot be found in a natural deposit, the specification of pebbles would imply the necessity for preparation, thus rendering the material fit for use as concrete aggregate.

## Lost Time with Motor Trucks

IN ORDER to realize the greatest benefits from motor-truck haulage on contract work it is necessary to give careful thought not only to the machine itself but to the method of operation. It is not enough to purchase good trucks, man them with intelligent drivers, and keep the outfits in repair by replacing broken or worn-out parts. The motor truck is a high-priced plant unit and the economies which it can effect can be realized only if it is kept on the road actually hauling materials. It is the time lost in loading and unloading that eats into the profits of motor-truck haulage. Therefore, the contractor who devises methods for reducing delays at the ends of the route will be amply repaid for his trouble. This point was emphasized by several English engineers at the conference of the Institution of Municipal and County Engineers in Westminster last summer. Ernest J. Elford, borough engineer of Southend-on-Sea, summed up the matter when he said that, from the financial point of view, the most important factor is rapid loading and discharging. Loss of time with motors makes all the difference between profit and loss. It is essential, therefore, that good facilities for loading and unloading be provided, so that as large a proportion as possible of the working hours be spent in traveling. There is, of course, nothing new in this advice. Too often, however, analysis of delays is neglected, and the owner does not know whether he is getting the most out of his plant. Contractors with motor trucks will do well to analyze the idle time of their machines and study the possibilities of increased efficiency by better organization of their loading and unloading operations.

## Disregarding Facts for Expediency

WHENEVER utilities, particularly railroads, attempt to get into reproduction cost, for valuation purposes, figures for land that show, what all railroad real-estate men know, how much in excess of normal market value railroads have to pay for their right-of-way, they are confronted with that section of the Minnesota rate decision which states that multipliers based on mere conjecture cannot be allowed. The insincerity of some who quote that decision is typified by the opinion of the Railroad Commission of California on the valuation of the Quincy Western Railway, briefly abstracted on page 698. Here the realm of conjecture is replaced by one of absolute fact, for the reason that the road was built only five years ago, and the company actually did pay three times the normal market value for its right-of-way. Nevertheless Commissioner Loveland would disallow this multiple, even calling upon the Minnesota decision to support his view. He makes no accusation of extravagance or bad judgment on the company's part in its land transactions. True, he mentions peculiar conditions that forced the company to pay an abnormal price, and if these conditions have changed the multiple for the reproduction cost should be modified accordingly. He does not say, however, that conditions have changed, and his manner of referring to "a special and higher 'railroad value'" and "actual present-day average conditions" suggests that he would probably consider the amount any railroad paid at any time abnormally high. If so, he does not seem to agree with the view expressed at the recent Philadelphia conference by John M. Eshleman, formerly president of his commission, that the company is entitled to a fair return on the actual investment. Rather, he seems to support what this journal has already suggested, that some commissioners are as ready to advocate whatever basis gives the lowest valuation as the utilities are to claim whatever gives the highest. It would be interesting to know whether Commissioner Loveland would apply the "basis of actual present-day average conditions" to donated lands, and disregard the fact of the donation on the ground that land is not often donated in the general market.

## Quick Action and the Bond Market

LAST week the Engineering Record in its leading editorial urged engineers to put their work for next year under contract just as soon as possible. Quick action will insure the best prices obtainable next year, and also give greater certainty that the work will be done. The shortage of steel promises to be such that work let late in the spring will have to be postponed for another season, not only because the steel actually entering into the construction will be difficult to secure, but because contractors will not be able to buy new plant. Already the manufacturers of contractors' equipment are having difficulty in securing adequate stocks.

With the newspapers filled with stories regarding the present state of the steel trade, it is not difficult to convince engineers that an unprecedented condition will face them next year. Their natural inquiry, however, will be regarding the possibility of securing the necessary funds. On this subject one can speak with certainty and with emphasis.

Not for many years has the market for high-grade bonds been as good as it is now. Money is plentiful and promises to be so for some time, unless the war should suddenly end. Such a condition naturally results in turning the attention of investors to high-grade securities.

Particularly is the municipal bond market in a favorable condition just now. In fact, the demand is better than it has been for six years. About eighteen months ago municipalities were very active in putting out securities. For a time, in fact, the market was flooded. These issues, however, have all been absorbed and the supply is now less than the demand. Whereas under normal bond conditions high-grade securities sell on a 4.10 to 4.40 per cent basis, high-grade issues are now being marketed at 3.80 to 4.10. For example, the bonds of the city of Buffalo are selling on a 3.85 basis. The conditions are somewhat exceptional in New York just now, because of taxation agitation, but in general high-grade municipals are on less than a 4 per cent basis.

The condition, therefore, is very favorable for municipalities and other interests with high credit. If they contemplate doing work next year, they can do no better than to get their securities on the market at once and then let the necessary contracts for their work. Forehandedness is certain to be well repaid under the present abnormal conditions.

## This Lax Inspection Typical

A CASE of lax lumber inspection has recently been given publicity in Chicago. It appears that 1,100,000 ft. of No. 1 common longleaf pine was ordered for the construction of a new pumping station for the city. Apparently the timbers were carefully inspected for injurious wind shakes, unsound and loose knots and other defects, though little attention was paid to species, at least in the earlier shipments. While many of the timbers were probably on the border line—might have been longleaf, shortleaf or loblolly—a certain other proportion, and quite a sizeable one, could not have been anything else than loblolly or shortleaf. The lax inspection was discovered and the later shipments, presumably, have been examined with reference to the specifications as a whole.

While considerable comment has been made on the case in Chicago, the Engineering Record knows from inquiry among lumber interests that lax inspection of this sort is very common. It seems to be due, too, to ignorance on the part not only of the inspectors but of the purchasing departments, and applies not only to big cities but to million-dollar corporations as well. Within the year there have been two very flagrant examples of the sort at New York, both shipments going to big corporations—one an industrial concern of international prominence, and the other one of the largest railroads in the country. In both cases the shipments, while made on a longleaf specification basis, were composed of 30 to 40 per cent of timbers very evidently of loblolly or shortleaf origin. Yet the dealers were getting longleaf prices, while the engineers had predicated their designs upon the use of the stronger material for the structures they intended to build.

Apparently, then, the lumber dealers are not alone at fault. While their dishonesty cannot be condoned, one cannot but condemn also the ignorance of the purchasing and inspection divisions which accept the materials not complying with specifications. It is just these conditions which have resulted in the agitation for better specifications and higher standards of timber marketing within the last few years.

The practical application of the incident should not be lost upon the reader. If he is specifying timbers it is his duty to see that his inspectors really know how to pass intelligently upon the material being bought. Certainly the engineers of the railroad and of the industrial company at New York who were getting 30 to 40 per cent of shortleaf on a longleaf order did not concern themselves much about what their purchasing and inspection divisions were doing.

## Responsibility of Methods for the Quality of Concrete

ELSEWHERE in these columns comment is made upon the great number of studies which have been made on the nature of concrete. More of these, however, have been directed at the quality of the materials, at the variation in proportions, at the effect of different combinations of concrete and steel. Rare and superficial have been the studies of mixing and placing, while the design of mixing machinery, given much study from the mechanical standpoint, has had relatively little thought put upon the actual mixing process itself.

In this issue Nathan C. Johnson begins a series of articles which are directed not at the materials or the inner constitution of concrete, but at the mixing and placing methods. The burden of his argument is that the methods are no less important than the materials. He does not state that they are more important, but it would be easy to conclude from the evidence he adduces that such is the case.

We have rightly heard much criticism of late against "batch-a-minute" concrete. Mr. Johnson's argument backs up those who have criticised current methods. He contends, however, that time-economy is a factor that cannot be overlooked, and while he deplores the quality of material produced under present "batch-a-minute" procedure he insists that this ideal should be kept in mind. In other words, if by a different type of mixing apparatus, or auxiliary equipment to be used in connection with present types, first-class material can be secured at the "batch-a-minute" rate, he is strongly in favor of adherence to the present time ideal.

His articles, therefore, will be as much welcomed by the practical man as by those who on theoretical grounds are fighting for a better product.

A word, finally, as to the method he employs—the motion-picture camera. This instrument has been effectively used in making studies in industrial establishments. Now that Mr. Johnson has shown its possibilities in the concrete field, can we not confidently look for its extension in other directions having a direct bearing on the work of the civil engineer and the contractor? For the work on which Mr. Johnson used it, its advantages are obvious and striking. As engineering grows more complex, new methods of research and new instruments of investigation are to be expected. Possibly not the least of these will be the moving-picture machine.

## Contract Fallacies from Australia

IF the report of Maurice E. Kernot, abstracted on another page of this issue, is a fair index of the way the Australian Government has dealt with railroad contractors, it is not strange that the contract work has proved unprofitable for both parties. It would prove so in this country, or in any other where only outline plans and specifications were furnished to bidders; where anyone who could get financial backing was allowed to take contracts, whether or not he had equipment or previous experience; where, although long delays occurred in preparing plans and letting contracts, the actual time allowed for figuring the work was very brief; where the contractor was invariably held to unprofitable mistakes, and had to assume every risk, and where a premium was put on procrastination by invariably failing to enforce time contracts. The marvel is that the Government was able to find any contractors worthy of the name who would do business under such a system. Certainly no American railroad can run its affairs that way and expect to make its new construction pay dividends. The advantages claimed by Mr. Kernot for the day-labor system are doubtless actual when compared with such a contract system, though his chief arguments are based on fallacies so hoary that they are almost forgotten in this country. Where work is started on the heels of the surveying parties, it goes without saying that the location is apt to suffer. The location becomes permanent before matters like river crossings and other troublesome features can be properly decided.

To say that the staff required to prosecute the work by day labor is only half what it was under the contract system is merely saying that the former system was conducted by the Government in a ridiculously extravagant fashion. Under proper conditions competition so cuts down the return to the contractor that the abnormal profit, of which Mr. Kernot speaks, is nonexistent. By and large, contractors are rewarded in proportion to their skill and the risks they take. On broad economic grounds, therefore, contracting is no more profitable than other lines of business requiring equally sound judgment and ability. Actual experience, too, bears out the theory, as all contractors and fair-minded engineers will testify. Had the conditions of contract work in Australia been fair, the alleged advantages of the day labor which Mr. Kernot sees would not have existed.

## Labor Decisions Which Affect Contract Work

TWO labor decisions of the greatest importance to those concerned with the cost and execution of engineering work have been handed down within a month by the United States Supreme Court. Both of them are on anti-alien labor laws—the one in the so-called Arizona case, and the other involving the employment of aliens in the construction of New York's subway. The decision in the Arizona case was handed down Nov. 1, while the court announced its findings in the New York case Nov. 29. Of the two, the New York case has the more immediate bearing on construction work, though the ramifications and possibilities of the Arizona law were so much greater that had the State been sustained the precedent might have become a serious menace not only to all construction work, but to industry in general. The importance of the cases is therefore apparent.

Briefly put, the court declared that the Arizona law was unconstitutional and that the State could not limit the percentage of aliens employed on private work. The New York case did not concern private work, but was concerned solely with the employment of aliens on public work. Here the judgment of the Supreme Court affirms the validity of the statute. It has, therefore, been established that any State has it in its power to prohibit the employment of aliens on public work, whether done with State funds and under State supervision or under any of the governmental divisions subordinate to the State—counties, cities, villages, townships and district organizations.

Arizona's anti-alien law provided that any company, partnership, association or individual who employed more than five workers at a time must employ not less than 80 per cent qualified electors or native-born citizens of the United States. An employee discharged as a result of the enactment brought suit, contending that the law was in violation of his rights under the Fourteenth Amendment to the Constitution. The special court of three judges convened to hear the case supported the plaintiff, and his position has now been affirmed as correct by the Supreme Court.

Touching the authority of the State to promote the health, safety, morals and welfare of those within its jurisdiction, the justification sought for the act, the court says:

"But this admitted authority, with the broad range of legislative discretion that it implies, does not go so far as to make it possible for the State to deny to lawful inhabitants, because of their race or nationality, the ordinary means of earning a livelihood. It requires no argument to show that the right to work for a living in the common occupations of the community is of the very essence of the personal freedom and opportunity that it was the purpose of the (Fourteenth) Amendment to secure. If this could be refused solely upon the ground of race or nationality, the prohibition of the denial to any person of the equal protection of the laws would be a barren form of words. . . . . The authority to control immigration—to admit or exclude aliens—is vested solely in the Federal Government. The assertion of an authority to deny aliens the opportunity of earning a livelihood when lawfully admitted to the State would be tantamount to the assertion of the right to deny them entrance and abode, for in ordinary cases they cannot live where they cannot work, and, if such a policy were permissible, the practical result would be that those lawfully admitted to the country under the authority of the acts of Congress, instead of enjoying in a substantial sense and in their full scope the privileges conferred by the admission, would be segregated in such of the States as chose to offer hospitality."

It was also argued by the state that the act was not in contravention of the rights of aliens, because it was not "a total deprivation of the right of the alien to labor"; that is, that the restriction applied only to businesses and persons having more than five employees, and to the ratio fixed. As to this contention the court says:

"If the State is at liberty to treat the employment of aliens as in itself a peril requiring restraint, regardless of kind or class of work, it cannot be denied that the authority exists to make its measures to that end effective. If the restriction to 20 per cent now imposed is maintainable the State undoubtedly has the power if it sees fit to make the percentage less. We have nothing before us to justify the limitation to 20 per cent save the judgment expressed in the enactment, and if that is sufficient, it is difficult to see why the apprehension and conviction thus evidenced would not be sufficient were the restriction extended so as to permit only 10 per cent of the employees to be aliens or even a less percentage, or were it made applicable to all businesses in which more than three workers were employed instead of applying to those employing more than five. . . . The discrimination is against aliens as such in competition with citizens in the described range of enterprises and in our opinion it clearly falls under the condemnation of the fundamental law."

The New York case is decided on the same basis as that taken by the Court of Appeals of the State of New York. Justice McKenna in his opinion quotes from a previous decision of the United States Supreme Court to the effect that "it belongs to the State, as guardian and trustee for its people, and having control of its affairs, to prescribe the conditions upon which it will permit public work to be done in its behalf, or on behalf of its municipalities. . . . No court has authority to review its action in this respect. Regulations on this subject suggest only consideration of public policy. And with such considerations the courts have no concern."

Further in the decision the court says that "the labor law of New York and its threatened enforcement do not violate the Fourteenth Amendment or the rights of the plaintiff in error under the provisions of the treaty with Italy."

Other contentions are considered but are completely swept aside. Governmental agencies throughout the country, and contractors working for them, or accustomed to do public work, may, therefore, take it for granted that the anti-alien statutes, where they exist, are valid. Further violation of them, accordingly, will be at considerable risk.

One cannot but rejoice that the Arizona law was declared invalid. Had it been supported the possibilities for mischief are almost impossible to estimate. Very likely in the States that would be most seriously affected, the industrial centers of the Middle West and the East, public opinion would have prevented the enactment of a similar statute. Yet vigorous labor unions can accomplish much, as witness the full-crew laws which have been imposed on the railroads.

As to the prohibition of aliens on public work, this journal repeats its former position that it considers such an enactment unwise. If the Government allows aliens to come into this country, its subordinate divisions should not be the first to refuse them employment. Simply and solely the laws are an evidence of the power of the labor unions.

# Materials vs. Methods—Testimony of Moving Pictures in the Study of Concrete

## First of Three Articles on the Making of Better Concrete—Part I, on Mixing, Suggests Necessary Function of a Concrete Mixer, and Points Out the Evils of the Short Mixing Period

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[*Methods, and not merely materials, are to blame for bad concrete—or, as Mr. Johnson puts it, will be largely responsible, when improved, for better concrete. In this series of articles he takes up the handling of concrete from the raw materials, through the mixing and transportation stages, to the product in place. The common errors in hand and machine mixing, in distributing with carts and with chutes, are studied with the aid of moving pictures. Remedies are indicated, so that the series will stand as a constructive contribution to the literature of the subject.*—EDITOR.]

IN BUYING and selling services for construction work, cost and profit are necessarily primary considerations. Quality of commodities is assumed commensurate with the price paid, but in concrete work, either no guarantees, or at most only limited guarantees, as to endurance are either asked or given.

This question of dollars and cents pivots on the element of time. Therefore, from the standpoint of money consideration alone, *SPEED* is of prime importance to construction undertakings. The wages men earn, the interest on money invested, or money borrowed, all increase with time; and in addition, the contractor is usually under a time limit for completion, since the owner desires to use the structure as soon as possible, to minimize the time his capital is invested without return. And in concrete work in the North, a further potent reason for economy of time is the briefness of the open season.

### CARELESSNESS

Necessarily, however, this demand for speed and saving of time has resulted in carelessness of working methods. Remembering that the dependence for strength in all concrete rests primarily upon a chemical reaction between water and cement; that each of these substances is as important as the other; that to insure this chemical reaction taking place properly, a certain amount of mechanical manipulation is necessary to bring about incorporation of the liquid and dry materials; and that definite quantities only will serve to produce proper results, it is plain that haphazard deviation from these requirements must bring about, at best, uncertainty of result.

If all concretes were thoroughly satisfactory there would be no need for this investigation, or of the many other investigations that are being carried on to-day at great labor and expense, with a view to finding the secret of better concrete. Unfortunately it is all too true that these investigations are warranted. Without attempting to estimate their percentage of the total, it is evident to all who deal with concrete that defective constructions, in which signs of deterioration show to a greater or less degree according to local conditions, are regrettably prevalent. Indeed, so common are these defective concretes and so accustomed have we become to seeing them, that citation of unsatisfactory conditions is met with statements that such disintegrations (to quote literally) are "natural to the material" or that "they always happen in concrete" or that they "really do no harm." In other words, structural standards for concrete have been unconsciously lowered to meet supposed limitations imposed by lack of appreciation and understanding of the real nature and possibilities of the material.

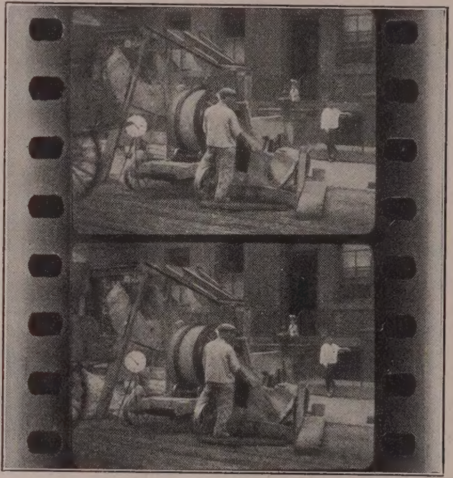

FIG. 1—CONCRETE IS BEING DISCHARGED AT ONE SIDE WHILE MIXER IS BEING CHARGED AT OTHER

Granting, then, the need for general improvement in the quality of concrete; and remembering that concrete is a composite produced by the mixture and manipulation of cement, sand, stone and water, it is evident that either the quality of the materials must be at fault or else the processes during and after manufacture must be held responsible for any inferiority. Eliminating the qualities of materials from present consideration, because of the extensive study already devoted to them, it seems possible that valuable knowledge may be gained by considering carefully the mixing and placing of the materials.

### TIME OF MIXING

Any investigation of process troubles may properly start with a determination of the time-cost-per-cubic-yard for each phase of the manipulation, together with the effect of such costs upon the proper performance of each operation.

In this motion picture study, attention was therefore first directed to this time-cost factor as it might affect the process of mixing. To determine its value, both hand-mixing and machine-mixing methods were investigated, a considerable number of jobs, covering different classes of work being studied on all-day runs. On fourteen machine-mixed jobs, timing records were taken, with a large seconds-clock in the field of the motion-picture film, in order that each phase of the cycle might be timed with precision; and these camera studies were supplemented by others with a stop-watch. It should also be understood that for each second's duration of any process photographed, from 16 to 30 separate pictures are made, or for each minute's duration, from 960 to 1800 separate pictures, according to the speed with which the camera crank is turned. Not only does this result in a large mass of data, especially when it is remembered that some 35,000 such individual pictures have been made and studied in the course of this research, but it further gives very accurate data as to the processes under investigation. Timing data in regard to mixing as obtained by this means, together with long-time observations taken by stop-watch on the same jobs, are given in Table 1.

### RESULTS OF TIME STUDIES

In these time studies, it is interesting to note, first, that the average duration of actual mixing for all jobs is but 28 sec.; and that omitting two jobs, on which the material could not be disposed of as fast as made, this is lowered to 17 sec. Nor is it unusual to find on individual runs 4 or 5 sec. only given to mixing, with, in some

TABLE 1—SUMMARY OF TIMING DATA ON CONCRETE MIXERS
Time given in minutes and seconds.

| Run No. | Kind of mixer | Loading means | Loading | Unloading | Actual mixing | Actual total | Loading and unloading, total | Time of mixing batch, minimum schedule |
|---|---|---|---|---|---|---|---|---|
| 1 | Lakewood, 1 yd | Batch hopper | 0:51 | 0:59 | 0:11 | 2:02 | 1:50 | —0:50 |
| 2 | Koehring, 1 yd | Batch hopper | 0:36 | 0:34 | 0:42 | 1:51 | 1:10 | —0:10 |
| 3 | Smith, ¾ yd | Batch hopper | 0:15 | 0:19 | 0:25 | 1:01 | 0:34 | +0:26 |
| 4 | Foote, ¼ yd | Side loader | 0:16 | 0:17 | 0:20 | 0:54 | 0:33 | +0:27 |
| 5 | Foote, ½ yd | Side loader | 0:23 | 0:27 | 0:25 | 1:15 | 0:50 | +0:10 |
| 6 | Chain Belt, ½ yd | Side loader | 0:07 | 0:35 | 0:28 | 1:10 | 0:42 | +0:18 |
| 7 | Koehring, ½ yd | Side loader | 0:12 | 0:32 | 0:21 | 1:05 | 0:44 | +0:16 |
| 8 | Lakewood, 1 yd | Side loader | 0:11 | 1:02 | 1:11 | 2:25 | 1:12 | —0:12 |
| 9 | Ransome, 1 yd | Batch hopper | 0:35 | 0:40 | 1:40 | 2:57 | 1:15 | —0:15 |
| 10 | Ransome, ¼ yd | Side loader | 0:08 | 0:12 | 0:54 | 1:10 | 0:20 | +0:40 |
| 11 | Chain Belt, ¼ yd | Side loader | 0:13 | 0:27 | 0:11 | 0:51 | 0:40 | +0:20 |
| 12 | Ransome, ¼ yd | Side loader | 0:18 | 0:38 | 0:46 | 1:32 | 0:56 | +0:04 |
| 13 | Koehring | Side loader | 0:17 | 0:29 | 0:20 | 1:06 | 0:46 | +0:15 |
| Average | | | 0:21 | 0:33 | 0:28 | 1:29 | 0:53 | +0: 6 |
| Average, omitting 8 and 9 | | | 0:19 | 0:29 | 0:17 | 1:17 | 0:49 | +0:10 |

*Note*—Mixer 8 had very poor blading. Mixer 9 was fed by derrick bucket. Long mixing due to inability to get raw material and to dispose of mixed concrete.

extreme instances, the unmixed materials being delivered into one side of the machine at the same time that the "concrete" was being sent to the forms from the other.

Such mixing is clearly shown in the series of motion-picture photographs, Fig. 1. The materials are seen sliding from the hopper into the drum, at the same time that the flow of concrete continues from the discharge end. Nor is this an isolated case. It is found repeatedly; and in one case, while this exhibition was going on, the foreman was explaining that his mixer had worn blades and apologized because his gang, owing to being green, was below speed!

Evidently, on each of the jobs thus studied, the time-cost-per-cubic-yard for mixing has been cut as close as circumstances permitted; and it seems fair to assume that like conditions prevail generally, since all the contractors concerned are of good repute. But while this one desirable end, of low mixing cost, is thus attained by speeding up, what of its reaction on the quality of concrete? And how far may this brief time of mixing be held responsible for the recognized defects?

### Heavy-Bodied Grout

For instance, it is known beyond question that cement and water stirred together for 17 sec. do not give the heavy-bodied grout that is produced by more prolonged mixing. It is further known that cement stirred with water for this short period, particularly when the mixture is thin, tends to settle by gravity into layers of the several sizes of particles; and that equal quantities of like materials, when properly incorporated by prolonged mixing, do not tend thus to segregate, but form instead a heavy-bodied "gravy" capable of sustaining in suspension larger and heavier particles, such as sand or stone. And it is further known that the ultimate product produced by the first process is not the same as that produced by the second, but lacks in strength, hardness and durability—desired qualities in a substance which binds together the loose, inert materials of concrete. When these matters are considered, it seems possible that this gain in the time-cost-of-mixing factor may prove an ultimate loss, through its reaction on the quality and endurance of the concrete.

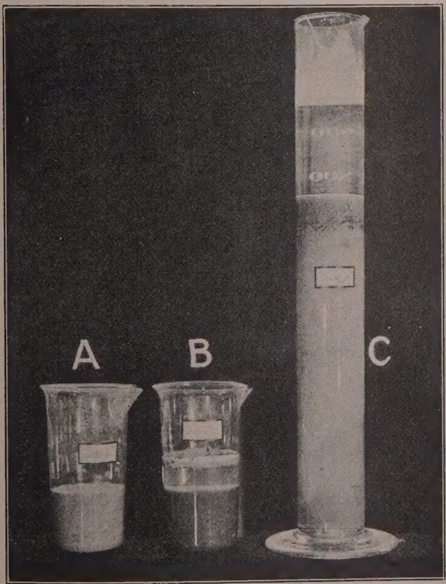

FIG. 2—EQUAL QUANTITIES OF CEMENT AFTER STIRRING WITH WATER FOR SHORT AND LONG PERIODS

(*a*) Dry cement. (*b*) Same quantity of cement mixed with water for 17 sec. (*c*) Same quantity of cement mixed with excess of water for 6 hr.

The comparative effects of long and short mixing of neat cement and water are made visually evident by Fig. 2. The first glass, (*a*), contains 200 grams of loose, dry cement. The second glass, (*b*), contains the same quantity of cement, mixed for 17 sec. with 100 per cent excess water over that required for normal consistency, photographed after being allowed to settle for 10 min. The third glass, (*c*), contains the same amount of cement stirred for 6 hr. with 500 per cent excess of water, photographed after settling for 96 hr. This latter excess is, of course, used for experimental purposes only.

It is needless to point out the volume ratios of (*b*) and (*c*) or their comparative surface-covering and void-filling ratios. Nor are the cementing properties of (*c*) destroyed. Experiments made by Michaelis have proved that with this "colloid," products of the greatest strength and durability may be produced; and the view first propounded by him that the most valuable properties of Portland cements are due mainly to colloidal products of hydration is steadily gaining in favor. Evidently, then, the source of many deficiencies of concrete might be sought with reason in the usually incomplete incorporation of cement and water brought about through undue emphasis on the time-cost element of the mixing process in the interest of initial economy. (For further discussions of extent of hydration in concretes see articles by the author in the Engineering Record, Feb. 6 and March 13, 1915, pages 160 and 320.)

### Actual Time of Mixing

But still further light is shed by these studies on the mixing of concrete. Following through the complete operation, note was made of the time required on each run for the batch to enter the mixing drum, whether the machine was charged by a side-loader skip, or by a batch hopper; of the time the materials were actually in the drum, from the last of the charging to the delivery of the first concrete; and lastly of the total time to discharge the mixer. In some cases the duration of these several operations was so prolonged that on a "batch-a-minute" schedule, which is probably the usual basis in the computation of concrete costs, the mixing time would be wholly negative.

The maintenance of a "batch-a-minute" schedule under such conditions would, of course, be an absurdity. Mixing of some sort is essential, for not only must the cement and water be properly incorporated to produce a binding substance, but the inert materials—the sand and the stone—must be covered closely with and filled between by this binding substance, if the concrete is to be dense and strong. But although it is to be granted that insufficient mixing may be responsible for a portion, at least, of any lack of quality and that longer mixing may be beneficial, it must yet be recognized that a low mixing time-cost is highly desirable; and that an increase of this factor, unless unavoidable, would impose a general hardship, particularly under conditions of competitive bidding, where "concrete is concrete" and money alone needs guarding.

With a view to overcoming this objection through increased mechanical efficiency and also to determine to what extent the time-of-mixing factor by itself should be held responsible for deficiencies of concrete, the actions that take place inside a concrete mixer of the common type were caught by the camera and carefully studied. As such a mixer is seen in operation by the human eye, the sequence of individual actions that go to make up the complete cycle is so rapid that they cannot be distinguished one from another. The camera, on the other hand, by recording an instantaneous and unconfused impression on the advancing film, catches these individual actions, and permits their being analyzed in later examination.

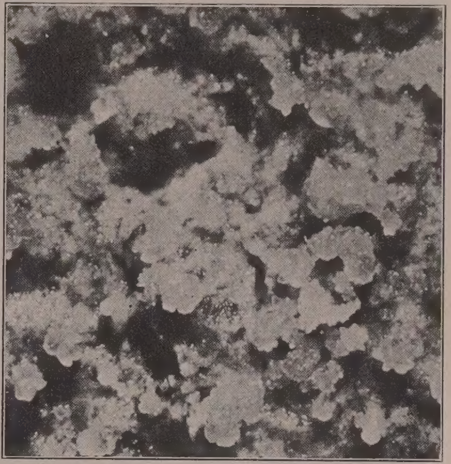

FIG. 3—ROUGH FRACTURE OF A WATER-SOAKED, DEFECTIVE CONCRETE

Cement mortar only showing. Each of loose, white spherules has within it a center of unhydrated cement. Enlargement, 100 diameters.

But in order to evaluate properly these process records, a thorough understanding must be obtained not only of the results it is possible to obtain through proper procedure, but also of those which are commonly secured through the usual mixing operations. For such an understanding, recourse is had to an intimate study of ailing concretes, in much the same way that physicians study ailing humanity, not to exaggerate ills, but to learn from disease how to mitigate its ravages and to prevent its recurrence.

### What "Ailing" Concretes Show

An examination of rough fractures of water-soaked, defective concretes reveals an interesting condition. The value of the colloidal, or amorphous constituent produced by proper union of cement and water has been already noted. Properly, the cement matrix, in which are embedded the sand grains and pieces of stone, should be an even-textured, structureless mass, if it is formed of colloid. What is usually found, however, is a structure that seems when magnified to be composed almost wholly of individual grains, white in color, spherical, or nearly-spherical, in form, possessing little attachment to their neighboring particles, so that they may be freely moved about by poking with a pin, the whole closely resembling a mass of white cornmeal mush.

These several features can be clearly seen in Fig. 3, taken through the microscope. Evidently, in such concretes the amorphous, or colloidal, products possible of production are at least in inferior quantity, if not wholly absent; and since other concretes, prepared with special regard to this production of colloid, exhibit a quite different structure; and since these latter do not possess the deficiencies of the non-colloidal concretes, it would seem that an undue reduction of the time-cost-of-mixing factor might prove to be poor economy in the long run.

It has been already shown that an increase of colloid without increased cement can be produced by prolonged stirring of cement and water. It is known further that 8 hr. or more of mixing produces concrete of a tacky consistency, quite unlike the loose, unregulated mixture generally made by the 17-sec. process. (See Bates, *Proceedings*, American Society for Testing Materials, 1915.) Yet such prolonged periods of mixing, though desirable from a quality standpoint, are economically prohibitive in commercial work.

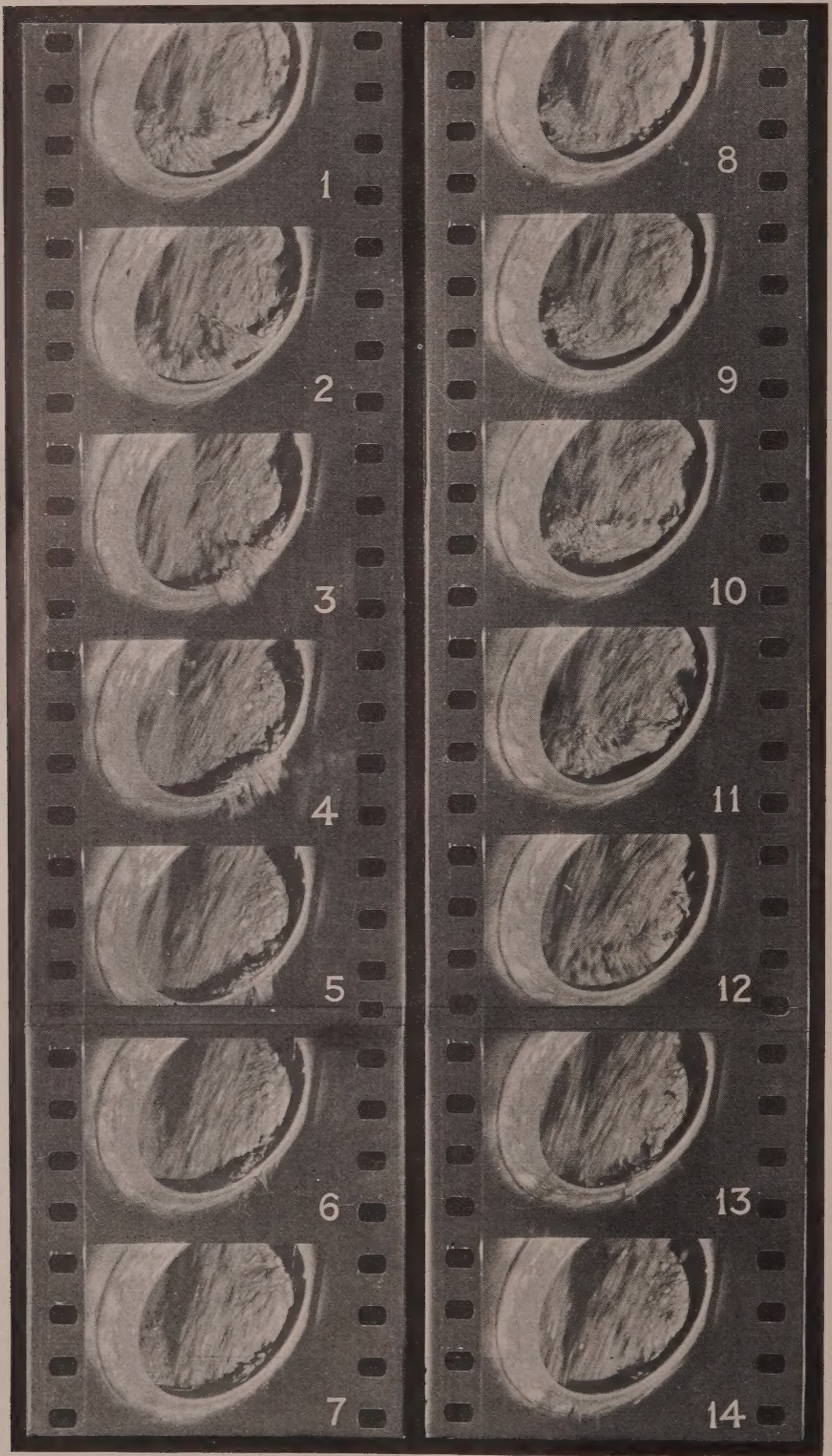

FIG. 4—CYCLE OF OPERATIONS IN A CONCRETE MIXER VIEWED FROM THE DISCHARGE END—ROTATION COUNTER-CLOCKWISE

1, 2—Rising bucket strikes falling concrete. 3, 4—Resulting splash and spill. 5, 6—Pieces of stone separate. 7, 8—Bucket begins to pour. 9, 10—Pour, aided by bucket above, increases. 11, 12—Grand splash to bottom. 13, 14—Next bucket starts it all over again.

Bearing in mind then, the spherical form of the grains found in defective concretes; knowing that calcium hydrate, produced in profusion during the reaction of cement with water, tends to take this crystal form; and realizing the low strength possessed by this substance and its possible masking within it of other and stronger products essential to durability, it is evident that a most desirable type of mixer would be one which by forcible, positive, mechanical means would grind off any isolating substance or substances formed by the first water contact. This would secure thorough and rapid contact between water and fresh, successive, layers of the individual grains of cement, thus producing in a shortened time a nearly perfect solution of cement, this solution to be used as a coating of, and filler between, the particles of aggregate. Furthermore, the whole process must be accomplished without prohibitive increase of time and without the requirements of expensive mechanisms or skilled labor, so that the time-cost-per-yard factor may be kept within permissible limits. Such a device would seem to be a large order, but it is not impossible that the studies of deficiencies in existing apparatus outlined in the following paragraphs will eventually lead to its development. The reality and extent of the need, with commensurate rewards, certainly offer sufficient incentive.

With this knowledge as to structural deficiencies of defective concretes and the process of mixing desirable, if not absolutely essential to their prevention, new appreciation is had of the usual mixer actions as portrayed on the film.

Furthermore, when it is remembered that while it is endeavored to incorporate the materials, it is also desired not to introduce an undue quantity of air into the mass, it is at once evident that at least this one principle of proper mixing is violated hundreds, if not thousands of times a minute, through the splashing, lifting and pouring brought about by the paddles, buckets and blades. The less air in concrete, the better its quality, for not only does occluded air displace solid, stress-resisting materials, but it further permits the later entrance of solvents and disintegrating agents into the mass. From this standpoint, the actions portrayed in sequence on the motion-picture films are highly undesirable, for the lifting, pouring and splashing must be churning air into the mass in an all-too-efficient manner. It it were desired to aerate the mass, the drop of plastic material from a height, the splashing and the wild turmoil, would be nearly ideal.

### "INSIDE THE DRUM" PICTURES

In Fig. 4 is shown the cycle of operations as observed from the discharge end of the mixer drum. Fig. 5 gives a few views from the charging end. Though it is possible to follow the operations at the charging end satisfactorily with the films, the prints do not reproduce well. In studying these records, it will be remembered that the materials, stone, sand and cement, charged into the drum, with water added at one time or other, are caught first by sloping transfer blades and advanced, with more or less stirring, to the forward end of the drum. Scoop blades of one form or another, attached to the drum interior at this end, then elevate them nearly to the top of the drum, when they are poured to the bottom. The transfer blades again advances them to the elevating scoops, and so on, through

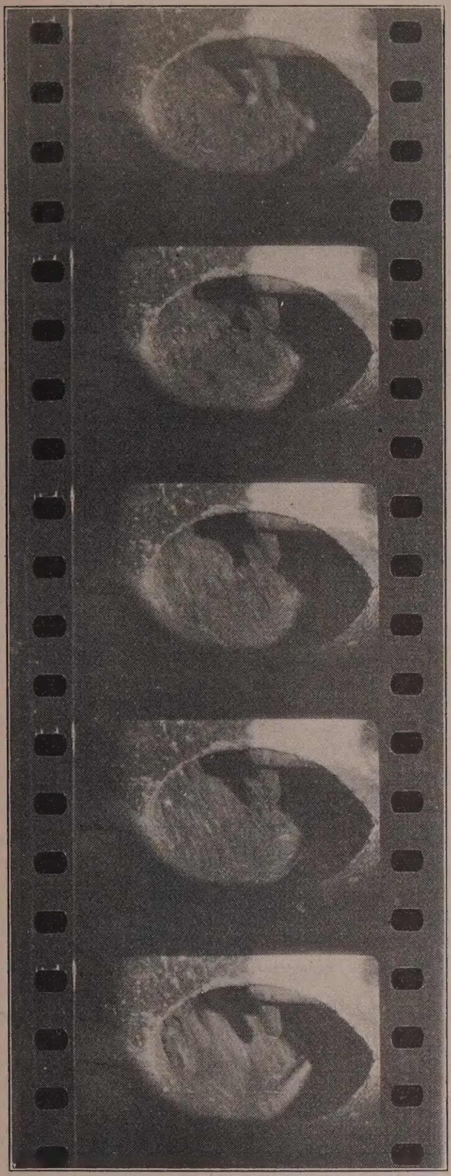

FIG. 5—CYCLE OF OPERATIONS VIEWED FROM THE CHARGING END—ROTATION CLOCKWISE

indefinite numbers of repeating cycles.

There is no question as to the efficiency of this process as a distributor of the several materials. But, aside from the question of churning air into the mass, is it producing that desirable solution of cement, through grinding with water of the individual particles, in so brief a time? Is it possible, especially in view of the superwetness of the average concrete, to secure this result through intimate contact of the sand and cement? And if this thick-bodied product is not thus secured, in what manner is segregation of sand and stone and unconverted cement to be prevented and a durable, uniform concrete to be obtained?

The answer is that few of the latent possibilities of concrete materials are now being realized, partly through the imperfections of these mixing processes. Water must occupy space when added to the mass; and unless it stays by itself, which is ridiculous to suggest, it must lie between the particles, fine or large. If it lies between the particles, as it is known to do, it prevents their contact. If it prevents their contact, it prohibits grinding actions by cushioning and lubricating, thus cutting down the proper supply of positively dissolved cement, wherewith the sand and stone may be covered, and their interparticle spaces and air voids filled. It is certainly important that the mixing-time-cost-per-yard of concrete be kept low, but if this is to be done without sacrificing strength and permanence, a new type of mixer, or an improvement on present types, must be developed. Its advent in the near future is not unlikely.

The operations analyzed above are very important in their effect, but they may not be held wholly responsible for process defects of concrete without further investigation. In the following papers of this series, other operations will be discussed in the light of motion picture studies, together with their economic and scientific bearing on the production of more durable concrete.

[*The second article in this series will appear in next week's issue.*]

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# Colonel Sohier Tells of California's Concrete Roads

Describes Methods of Construction and Maintenance at Meeting of Massachusetts Highway Association

An informal talk on California highway construction, by Col. W. D. Sohier, chairman of the Massachusetts Highway Commission, was a feature of the quarterly meeting of the Massachusetts Highway Association in Boston on Nov. 11.

Since 1912, Colonel Sohier said, about 1176 miles of State highway have been built in California under the general direction of Austin B. Fletcher, State highway engineer. By the end of this year $16,000,000 will have been expended out of a total appropriation of $18,000,000, and the State will vote this year on the expenditure of some $15,000,000 more in order to complete the State highway system. In the last five or six years the various counties have expended over $20,000,000 in constructing new roads, in addition to what the State is doing. The State work now completed consists of 306 miles, graded only; 800 miles of concrete with thin bituminous top; 21 miles of concrete with asphalt paving; 19 miles of oil macadam, penetration method; 17 miles of macadam with asphalt top (Topeka); and 13 miles of waterbound macadam.

## BULK OF ROADS ARE CONCRETE

Mr. Fletcher is building practically all his roads now of concrete, mostly 4 in. thick, though some of it is 4.5 in. thick. The mix is 1:2:4, the larger stone being 1¼ in. A most excellent sand is secured and all materials are tested in the laboratory before using. In most cases the concrete is cured by building small earth dikes, about 8 in. high, and 6 or 8 ft. apart, keeping the road covered with water, which often has to be piped 8 or 10 miles. This method cures better than an earth covering, especially in a hot climate. About 10 days are required for the setting of the concrete. The roads are now being paved 15 to 18 ft. wide in the country districts, the width of the grading in the valleys being 30 ft., and that of the location, from 60 to 100 ft.

The sand used on the 4-in. concrete roads in the valleys is rated at 90 per cent by the Ottawa standard. The concrete costs on an average $6.25 to $6.50 per cubic yard in place, cement being $1.40 net in bags. Oil surfacing, depending upon the oil and haul, costs from 7.75 to 10 cents per square yard, including the pea stone and sand.

In the country districts where the traffic is not extremely heavy, the roads are coated after three months or one year, as the case requires, with asphaltic oil from Cat Canyon. This oil has to be heated in a tank car and spread at about 325 deg. under pressure. In spreading, ¼ gal. is applied to the concrete and covered with pea stone, which is then rolled in. Another ¼ gal. is then spread and covered with an excellent grade of sand, the sand varying up to ¼ in. This is rolled in also, and the road is kept covered so that it will not pick up. Before applying the first coating the practice is to wait until the first scum on top of the concrete is worn off. Colonel Sohier saw some of these oiled surfaces in excellent condition after three years' service; at some places patching had been done. The average cost of maintenance is less than $20 per mile, and Mr. Fletcher's opinion was that the patches were made necessary because of lack of covering, thus allowing the oil to bleed on a hot day and pick up. In construction it was found impossible to make the oil stick to the concrete when it was fresh, until the traffic had worn off the first scum as above outlined.

The average cost of grading in the valleys is from $1,100 to $1,400 per mile for a 30-ft. width. The concrete roads are built on a natural base varying from adobe mud to silty sand.

On roads graded 30 ft. wide the average cost of construction is 87.5 cents per square yard for the 4-in. concrete, with a top which adds 7 to 9 cents per square yard.

## GRADING

All grading which Colonel Sohier observed in the West was being done with some form of steel shovel with either two or four horses when the material had to be moved more than 300 or 400 ft. The steel shovel is mounted on wheels. In other places a steel shovel drawn by two or four mules is used. The so-called Fresno drag has four mules. In hard material like hardpan a gang plow is sometimes employed to break up the material, after which the material is removed and placed for grading with the Fresno drag. Stones up to ½ cu. yd. are moved in this way.

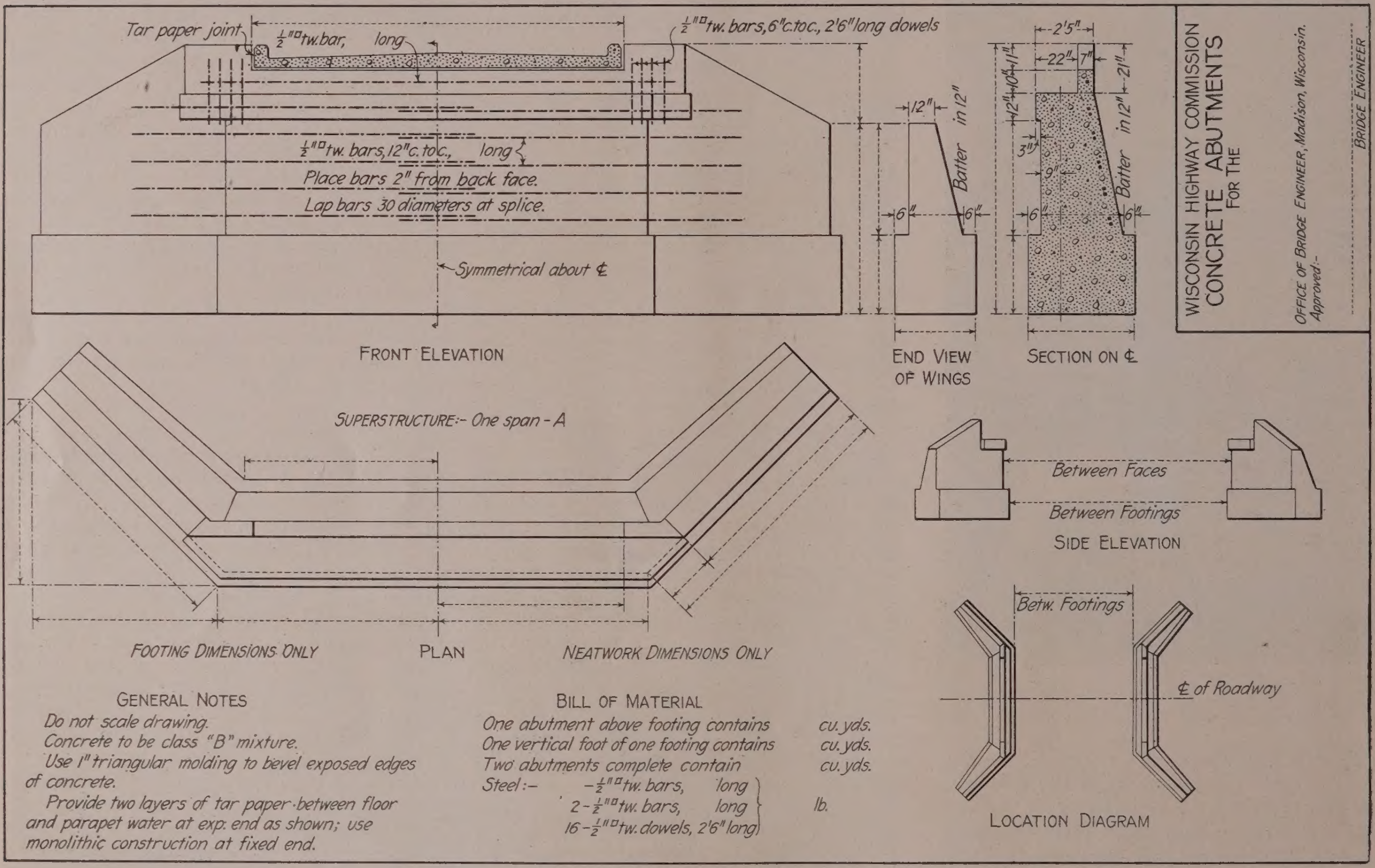
In getting gravel out of pits a skid is built up with a hole in the middle, excavating sufficiently below the skid to back in a team. Gravel is secured from a large area by the use of two horses and a steel scoop revolving around the pit, taking off successive layers and dumping from the shovel into the cart below the skid.

No expansion joints are laid by Mr. Fletcher in the 4-in. concrete roads. The concrete cracks transversely in the first year of service about as frequently as expansion joints are located in usual practice—every 25 to 30 ft. After the top scum is worn off by traffic the surface is brushed clean before the oil is applied; the first application of asphaltic oil then runs into the cracks and there is no surface indication that any crack has ever existed. The roads themselves look like first-class asphalt pavement at present. There are very few places where the asphaltic oil has peeled, patches being attributed, as stated, to insufficient covering. The Cat Canyon asphalt oil grades as 90 penetration and 80 per cent bitumen by the California standard. It is very sticky and costs 85 cents per barrel of 42 gal.

Mr. Fletcher expects to pave the whole mountain section with concrete before many years at an average cost of $28,000 per mile for the completed road. The crown on the concrete is ¼ in. per foot, and in most cases in the valleys there is no drainage except the side ditch. Mr. Fletcher states that although the mud formation swells a good deal in wet weather, in only one or two cases has it thrown the road up so that it will not come back. In some cases where he is building concrete the frosts are severe because of the 5000-ft. altitude. The valley roads are frequently subjected to very heavy commercial and farming traffic.

### ROAD OVER SIERRA NEVADAS

One road is being built over the Sierra Nevadas; it is 40 miles long and is to have a maximum grade of 7 per cent. The grading on the first section, 14 miles long, cost $10,500 per mile; on the second section, 14.5 miles long, $20,907 per mile. On this section there were 639,000 cu. yd. of excavation, the maximum cut being 126 ft. The contractor used steam shovels in the cuts and actually moved over 1,000,000 cu. yd. The price for unclassified excavation was 41 cents per cubic yard. This included taking out the rock, almost all of which could be done with steam shovels. Some concrete is used on the 7 per cent grade. The third section cost $15,938 a mile, since the grading was less heavy. The contractor had 150 days for moving the material. The average haul was 20 miles from the railroad. Natural gas was piped from a line in the district to the steam shovels. The contractor moved his material at an actual cost of 15 cents per square yard. On the mountain roads no guard rails are used. Colonel Sohier averred that guard rails are a snare and a delusion, because they are never strong enough to actually hold an automobile on the road, and where there are no guard rails, the moral hazard is so great that the driver operates slowly and keeps strictly to his own side of the road around corners.



GENERAL NOTES

Do not scale drawing.

Concrete to be class "B" mixture.

Use 1" triangular molding to bevel exposed edges of concrete.

Provide two layers of tar paper between floor and parapet water at exp. end as shown; use monolithic construction at fixed end.

BILL OF MATERIAL

One abutment above footing contains cu. yds.

One vertical foot of one footing contains cu. yds.

Two abutments complete contain cu. yds.

Steel:- —½"□tw. bars, long

2-½"□tw. bars, long } lb.

16-½"□tw. dowels, 2'6" long

THIS STANDARDIZED ABUTMENT DESIGN CAN BE USED FOR SPECIAL CASES

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## Wisconsin Using Standardized Bridge-Abutment Plans

How the State Highway Commission Has Simplified Abutment Designs—Use of Zinc Etchings and Table of Standard Quantities

DESPITE the great number of variations in abutments, the bridge department of the Wisconsin Highway Commission has evolved a method for standardizing abutment designs in such a way as to reduce appreciably the amount of drafting and still give an individual design for each substructure. The commission each year prepares plans and specifications for about 900 bridges of all sizes, the majority being steel bridges of moderate span. The superstructure designs were standardized at an early date, and the necessity of preparing a special superstructure design rarely arises.

### USUAL PRACTICE OF THE COMMISSION

The usual practice of the commission, according to M. W. Torkelson, bridge engineer, is to use mass concrete in abutments, making the thickness of the abutment at the footing equal to one-third of the distance from the roadway to the footing, with a bridge seat of the size necessary to carry the superstructure. These superstructures are of four types, I-beam, pony Warren girder, high Pratt truss and plate girder, the design of the abutments for each type not varying materially except at the bridge seat.

Typical drawings of abutments for each type of superstructure were prepared. These included all dimension lines and all constant dimensions, but omitted all varying dimensions. From these drawings zinc etchings were prepared and copies printed on thin white paper. A table was also prepared giving all variable dimensions for each difference of 1 ft. in elevation of abutments, together with the quantities of concrete in the battered work and the footing for each height computed. The computations included a combination of each height of abutment with three different lengths of wings.

### USE OF TABLE OF STANDARDS

Whenever it is desired to prepare an abutment plan for a case not presenting unusual features, the practice is to take one of the printed copies made from the zinc etching and supply all necessary dimensions, which, with the quantities, are taken directly from the table.

There is also, in the drawing, space for sketching a location diagram and for indicating all line and elevation monuments, and space in the title for indicating the date of the design and the name by which the particular bridge is known. The completed drawing is given its serial number, and as many copies as are desired are made by blueprinting. The drawing is then filed as a permanent record.

The economy in this method lies in the fact that nearly all the labor of making the drawing is avoided, it being necessary merely to supply the dimensions, and take the quantities from the table already prepared. Not only is the labor diminished, but opportunity for error in computing quantities is largely decreased.

# Wreck 15-Story Building and Replace with 17-Story Structure in 142 Days

### $16,000 Worth of Material and Labor per Day Put Into Construction of Skyscraper on Chicago's Busiest Corner

HIGH PROPERTY VALUES on the busiest street in the loop district of Chicago were responsible for the speed with which the 15-story Champlain Building was replaced by a 17-story structure 67 x 104 ft. in plan between July 18 and Nov. 1.

The old structure was wrecked in the ordinary manner, using Oxweld torches cutting close to the columns and girders in order to obtain as long shapes as possible. The structural steel recovered was in excellent condition, although it had been up 23 years, as described in the Engineering Record of Aug. 21, page 223. It is interesting to note that the steel shapes from the old building have already been placed in another building. Despite the fact that the corner of Madison and State Streets is one of the busiest in the city no accidents occurred either in the wrecking of the old structure or the erection of the new. The heavy traffic at the corner, however, made it difficult to store the materials. All material that could not be placed inside the building had to be delivered as needed.

As the Champlain Building was torn down the adjoining walls of the Boston Store were cut through and temporary partitions placed without interfering with the use of the elevators in the latter building or with its business. The supporting beams of the elevator guides were supported on the wall to be torn out, and, as a result, the beams had to be shored from top to bottom—17 stories. This was accomplished without accident or hindering elevator traffic.

Using air drills and wedges the old foundations, consisting of 12 or 15-in. I-beams with cast-iron separators concreted in the ordinary manner, were removed. The work was carried on day and night, excepting Sundays.

Open wells averaging 8¾ ft. in diameter and driven 93 ft. below the basement excavation were carried down to solid rock. The soil consisted of 50 ft. of blue clay, 10 ft. of stiff clay, 20 ft. of hardpan and the remaining distance to rock, a water bearing sand and gravel. The new foundations were completed in 16 days. The structural steel was set by two derricks, one carried up with the steel and the other placed on the roof of the adjacent building—the main portion of the Boston Store. The use of the former derrick was discontinued at the eighth floor.

All cutting for connections to the existing structure was made with acetylene torches, and measurements for steel had to be made at the site, rendering the furnishing of steel a relatively difficult procedure.

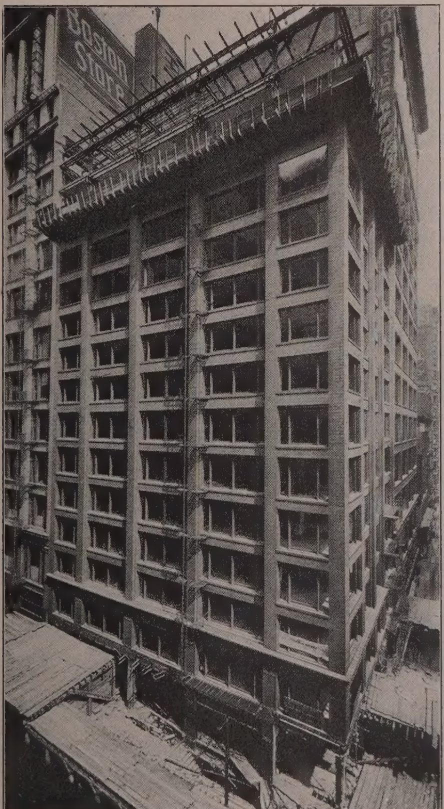
### SPECIAL STEEL ERECTION

The east panel of the Boston Store on Madison Street was found to be 2 ft. shorter than the standard panel length due to the former Champlain Building connection. In the new structure the plans called for all panels to be of the same length. As a result it was necessary to remove the old column and erect a new column 2 ft. east.

This was accomplished by erecting the steel of the new structure and then removing the old columns by starting at the top, shoring the spandrels from adjacent floors and transferring the spandrel to the new column by splicing a section of the spandrel girder. This was done without removing the masonry of the old building except where connections were made.

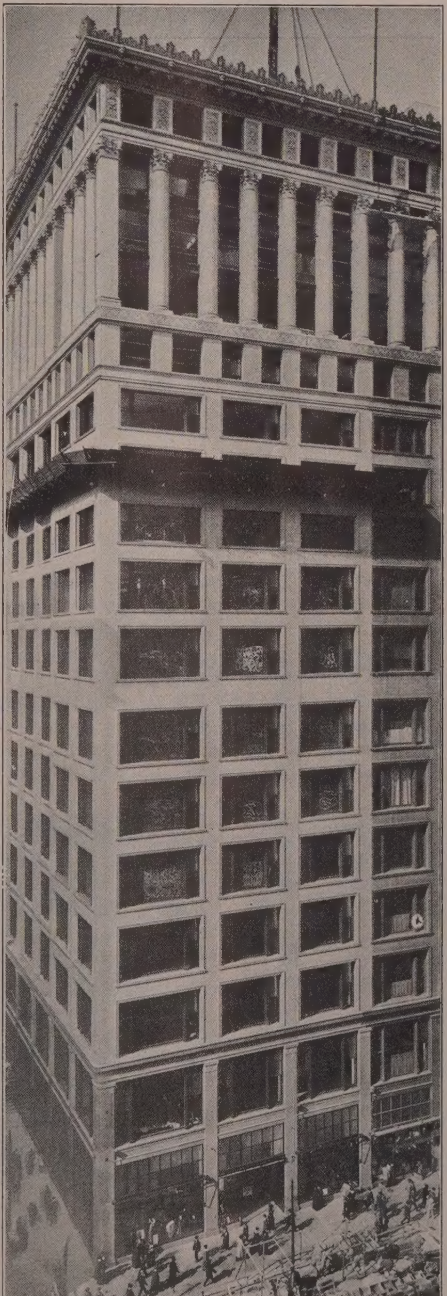
Fire-preventive measures were taken with all beams and girders by covering them with tile, except the tops which were concreted with 2 in. of 1:2:4 concrete. The terra cotta floor arches were placed between Aug. 16 and Sept. 24. All steel columns were protected with 4 in. of concrete. The beams were plastered with cement mortar before the installation of the arches.

In one month, September, 45 per cent of the total value of the work was completed and in another 20 days the first four floors were turned back to the owners for occupancy, in spite of the fact that a great deal of trouble was encountered with workmen. As many as 1000 were at times at work per shift. The erection was car-

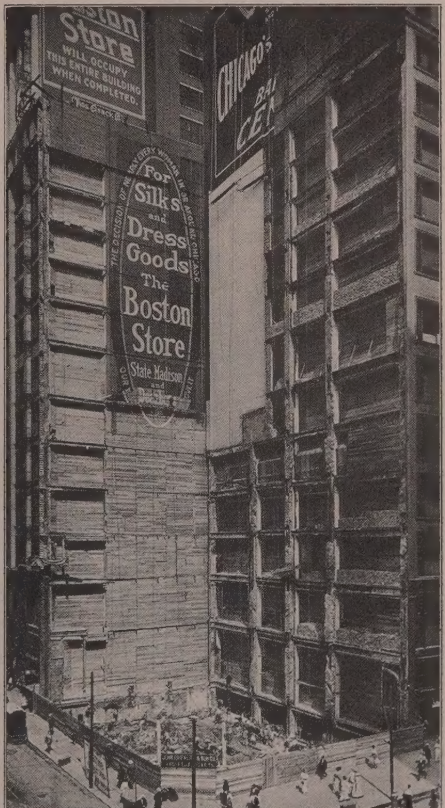


WRECKING THE OLD BUILDING JUNE 16

The structural steel recovered was in good condition.



NEW BUILDING WITH LOWER FLOORS OCCUPIED OCT. 21


Boston Store
WILL OCCUPY THIS ENTIRE BUILDING WHEN COMPLETED
For Silks and Dress Goods
The Boston Store
State Madison
CHICAGO'S

REMOVING OLD FOUNDATIONS JULY 16

Beams in building on left shored for seventeen stories.

ried on throughout every hour of the twenty-four, and 2500 tons of steel were erected and 10,000 tons of terra cotta were placed during this month of September.

The W. J. Newman Company was the contractor for the wrecking, and the structural steel was furnished by the American Bridge Company. John Griffiths & Son Company was the general building contractor. The Ruud-Nilsen Company was the shoring contractor and Holabird & Roche were the architects.

## Seattle Uses Ejector to Clean Sewer Catch Basins

**Three Men Remove 22 Cubic Yards of Detritus in One Day, Labor Costing $9 and Water $3**

By A. W. HOWARD
City Engineer's Office, Seattle

By adapting the principle of the hydraulic lift to the removal of detritus from catch basins the city of Seattle has been able, with ejectors, to effect marked economies in the maintenance of its sewerage system. Cost of maintenance is one of the factors in any sewer system. There are surface catch basins, sand catchers and the sewer to be cleaned at intervals and this work generally is slow and tedious, being done by hand in most of our large cities.

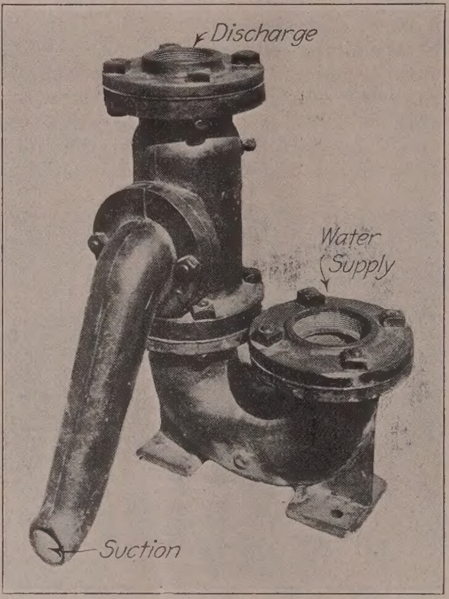
### GRIT CHAMBERS COLLECT DETRITUS

The City of Seattle, Wash., has just completed a large trunk sewer system, 22 miles in length. The sizes of sewer range from an 18-in. vitrified pipe to a 12-ft. concrete sewer draining approximately 10,000 acres. A large portion of the system is in districts that have no paved streets and, as a result, large quantities of sand, gravel and débris find their way into the sewer through manhole covers and catch basins. To collect this heavy detritus and hold it in one place large sand catchers or grit chambers were built in the line of the sewer. The sand catcher is divided by a central wall into two compartments so that the sewage flow can be shut off from one side while it is being cleaned.

The cleaning of these big chambers, each of which holds from 10 to 30 cu. yd. of detritus, has been quite a problem. Some of them have a depth of from 45 to 54 ft. and it was necessary to use a windlass and bucket to hoist the material to the surface. This was only part of the problem, however, for the reason that the detritus was so offensive that it had to be carted long distances to some convenient place and buried. This was necessarily expensive. The cost to the operating department of the city was from $45 to $60 every time one of these sand catchers was cleaned. It required the services of seven men and a team for two days and a half to clean both sides of the sand catchers.

### EJECTORS USED

The writer, at the request of A. H. Dimock, city engineer, spent some time trying to devise a more efficient method of cleaning these chambers and corresponded with a number of large cities of the East, but until recently could not discover any better method than the one in use. George Otterson, a mining engineer of Seattle, then suggested that the problem could be solved by the use of a hydraulic ejector. This ejector works on the same principle as any ordinary hydraulic lift, having a water supply pipe connected to a nozzle which throws a stream of water at high velocity through a contracted throat, thus creating a vacuum and causing a suction. The height that sand and gravel can be elevated by this ejector is governed entirely by the pressure of the water supply. It is very simple in its construction, as can be seen from cut. There are no movable parts to get out of order. All wearing parts are made of hardened steel, thus insuring a life of several years before they have to be replaced. When this is necessary it requires but a few minutes' time to slip the old parts out and put the new ones in place.



SAND EJECTOR HAS NO COMPLICATED PARTS

With Mr. Otterson's ejector it requires but three men for one day at a labor cost of $9 and water cost of about $3 to clean out both sides of a sand catcher holding about 22 cu. yd. The sand and gravel and all foreign material is thoroughly washed by the large quantity of clear water used in lifting it to the surface. It is collected in large settling basins on the surface, from which it is easily shoveled into wagons.

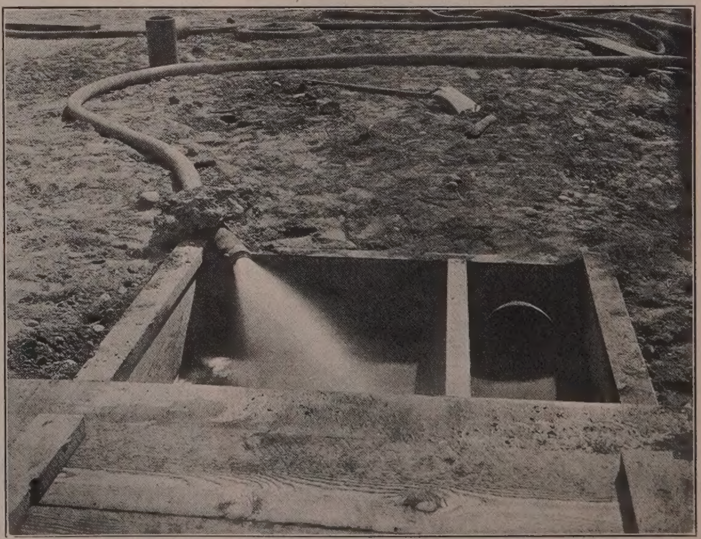
Because of the thorough washing all offensive matter is removed and the clear sand can be dumped in any convenient place. The use of the settling basin is temporary. It is expected that a suitable wagon will be built and the material deposited direct from the ejector into the wagon. The surplus water carrying organic matter and light material will be conducted back to the sewer by means of a suitable drain pipe and hose. This method will also do away with the little piles of offensive débris left by the cleaner alongside the catch basin until the wagon comes to remove it.

Seattle has installed seven of these ejectors. On one sand catcher it was necessary to install a double ejector, one above the other, the top one acting as a booster. This is necessary where there is a high lift and the water pressure is insufficient.

The last six ejectors have only recently been installed and as yet no reliable cost of operation has been secured, but there is no doubt but that they will show as great a percentage of efficiency as the first one installed. The single ejector can be installed complete for about $500.

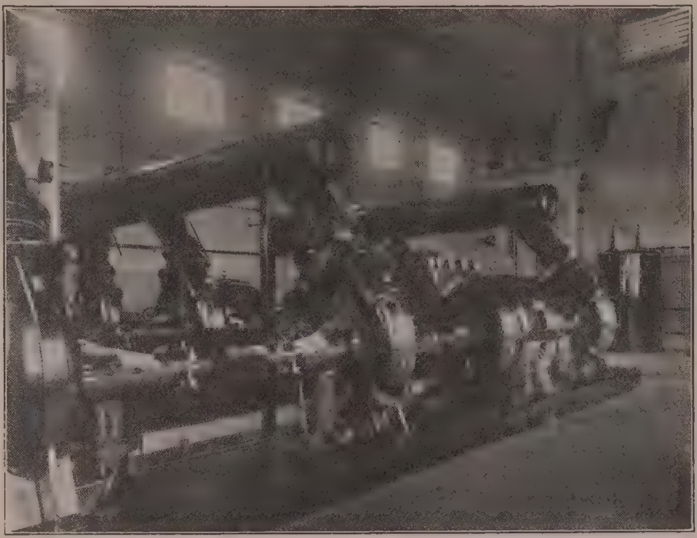
FOREST FIRES IN ALASKA during the past summer burned between 2,000,000 and 3,000,000 acres of timber, according to a recent report of H. S. Graves, chief forester of the United States, who made a tour of the northern territory. In the last fifteen years the area burned in Alaska comprised approximately 15,000,000 acres, Mr. Graves estimated, so that the destruction this year has been two or three times the average.

REMOVING SEWER BASIN MUCK WITH EJECTOR



TEMPORARY BASIN FOR STORING EJECTED MATERIAL

600-FOOT INLET CHANNEL LEADS TO PUMPING STATION



INTERIOR OF PUMPING STATION—NOTE OVERHEAD DISCHARGES

# Water for Prickly Pear Irrigation Project Raised 160 Feet with Financial Success

### Electrically Pumped Water Supplies Land Near Helena, Montana, from an Arm of Hauser Lake Formed by the Dam Where Power Is Generated

HAUSER Lake dam backs up water through a narrow canyon leading to the Missouri River from Prickly Pear Valley, a 50,000-acre saucer-shaped depression of fertile land lying to the northwest of Helena, Mont. The climate permits growing fruits, vegetables, grasses, grains and root crops. Plans for irrigation by pumping have been under consideration for a number of years. Early in 1912 the Montana Reservoir & Irrigation Company undertook the installation of the first unit, comprising 8000 acres of land on the north side of the valley. Water was in the ditches and everything in readiness for service within twelve months of the time work started. The company which owns the pumping plant and main canals now delivers water to the farmers' turnouts at $1.75 per acre-foot. Briefly, the plant consists of a pumping station housing three motor-driven units capable of delivering a total of 100 sec.-ft. of water equally to canals at three different levels through three 36-in. wood-stave pipes.

### PUMPING STATION

Nine 12-in. Allis-Chalmers centrifugal pumps are operated in three units, each unit being driven by one 600-hp. Allis-Chalmers induction motor so arranged that each motor is shaft connected to three pumps, each of which deliver into a different header or pipe line. This was done to give the greatest possible flexibility and economy in operation. The elevations of the three canals are 70, 110 and 150 ft. above normal lake level, and the pumps are so set that from 6 to 14 ft., varying with the lake level, of the total head pumped against is suction.

Electrical energy for operating the motors is obtained from the 70,000-volt transmission system of the Montana Power Company, three transformers stepping the voltage down to 2200.

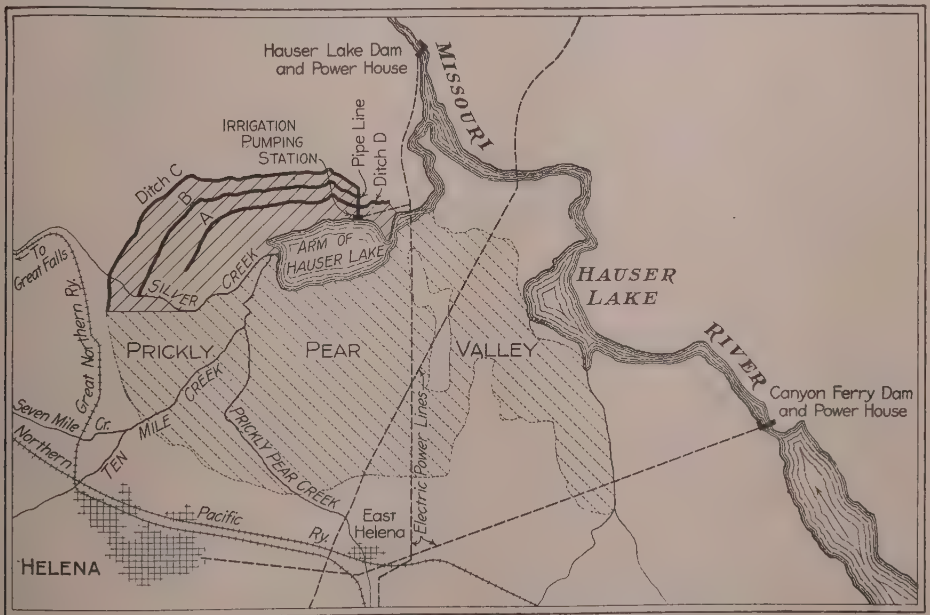
Leaving the lake, the water traverses 600 ft. through the inlet channel, which has a bottom width of 15 ft. with 1½ : 1 side slopes and a water depth of from 4 to 12 ft., varying with the lake level. The water enters the 28-ft. 9-in. x 38-ft. 4-in. suction chamber underlying that part of the pump house occupied by the pumping units. Three horizontal-shaft centrifugal pumps, discharging upward at an angle of 45 deg., are mounted with the motor on a single frame resting on an 18-in. concrete slab reinforced with 30-lb. rails in addition to the corrugated bar reinforcing. The rails were placed upside down.

### TAPERS

In a length of about 30 ft. the tapered steel headers over the pumps increase in size from 2 to 3 ft. from the entrance of the first tapered discharge to the connection with the wood-stave pipe, 9½ ft. outside the building. The pipe supports consist of 4 x 4-in. angles resting on the floor. The main line is of ¼-in. plates and the headers are of ⅜-in. plates. Provision is made at the back end for future extension to connect one more unit to each pipe.

Where the taper pipe passes the 18-in. wall of the pumping station two collars of 3½ x 2½ x ⅜-in. angles are riveted on, 7 in. apart. These collars and the skin friction are designed to transmit the impact pressures to the concrete wall and entirely remove them from the pumps. The maximum pressures were estimated for the pipe feeding the highest canal at 120,000 lb. total, under the assumption that the maximum pressure from small water hammer would increase the static pressure 100 per cent. As shown in one of the drawings, reinforced-concrete cantilever trusses forming the end of the substructure are designed to care for these loads.

The tapered suctions for the pumps are of 3/16-in. riveted steel plates, 2 ft. 6½ in. in diameter at the bottom and 14 in. at the pump connections. They extend to within 18 in. of the floor, above which the normal water level will be 7 ft. Two rows of the suctions are held against any tendency to sway by ⅝-in. and ¾-in. rods with turnbuckles running each way each side of the pipes to the concrete walls, in which anchor rods are



8000 ACRES ARE IRRIGATED BY FIRST UNIT, 3500 BY AUXILIARY PLANT

Only the land supplied by the first installation is cross-hatched, that first supplied being cross-hatched in solid lines.

embedded. The suctions for the other three pumps, set nearly over the outer wall, are offset away from it and are held in place by angle irons embedded in it.

The foundation for the substructure consists of a grillage of 12 x 12-in. timbers drift-bolted together. A floor of 3-in. planks, spiked to the grillage, forms the footing for the concrete side walls. To anchor the base of the walls to the foundation, ¾-in. drift bolts were driven with 1 ft. left projecting up into the concrete. A 12 x 12-in. timber all around the base on the inside was set to help care for the inward thrust of the earth when there is no water in the chamber.

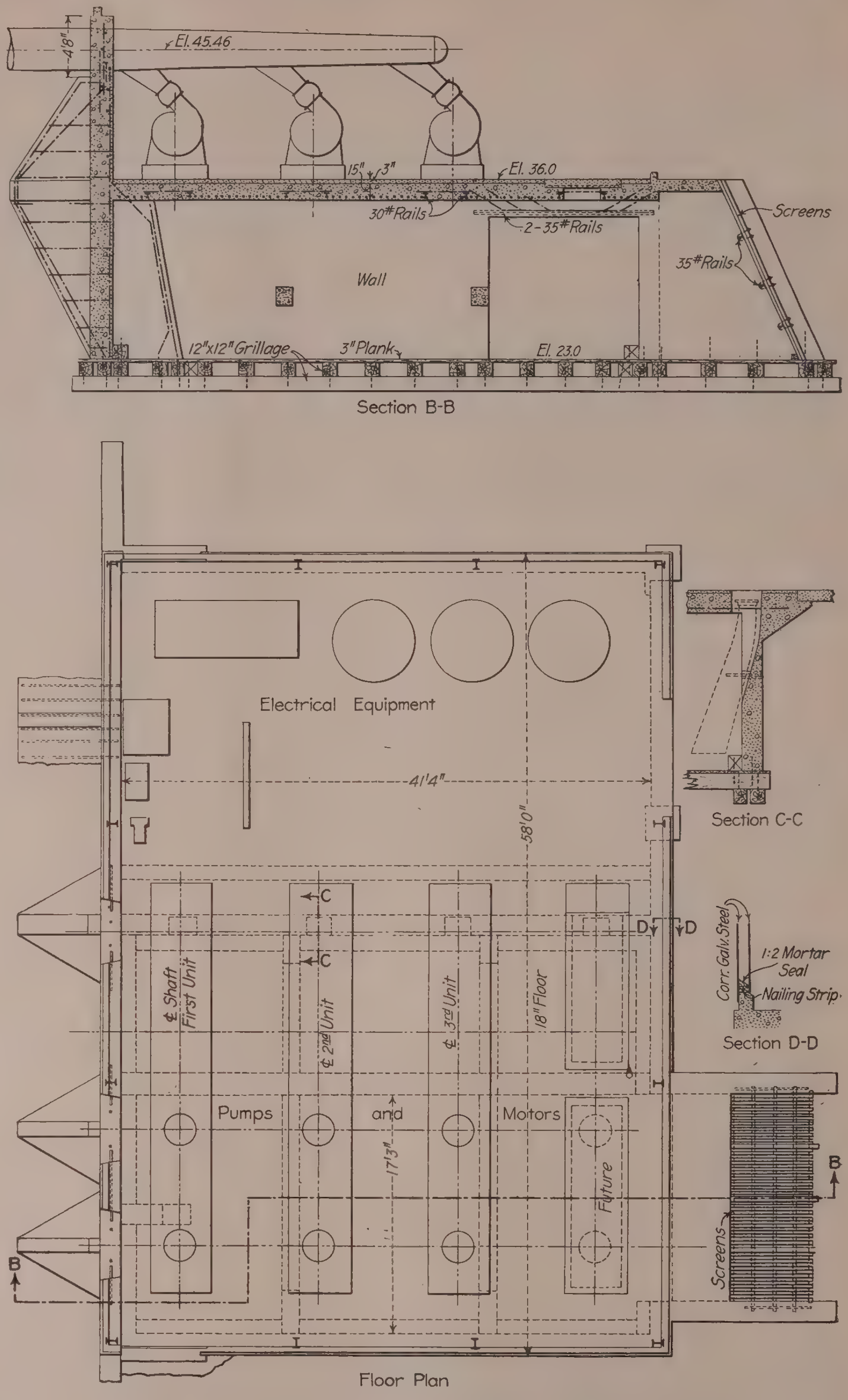
Above ground the station consists of inside and outside sheets of galvanized corrugated sheet metal over a steel frame supporting the crane girder, on which is a hand-operated 5-ton triplex block. The roof is of galvanized corrugated No. 24 plates supported on steel trusses. The Minneapolis Steel & Machinery Company furnished the steel material for the building, pipe headers and crane.

### PIPE LINES AND CANALS

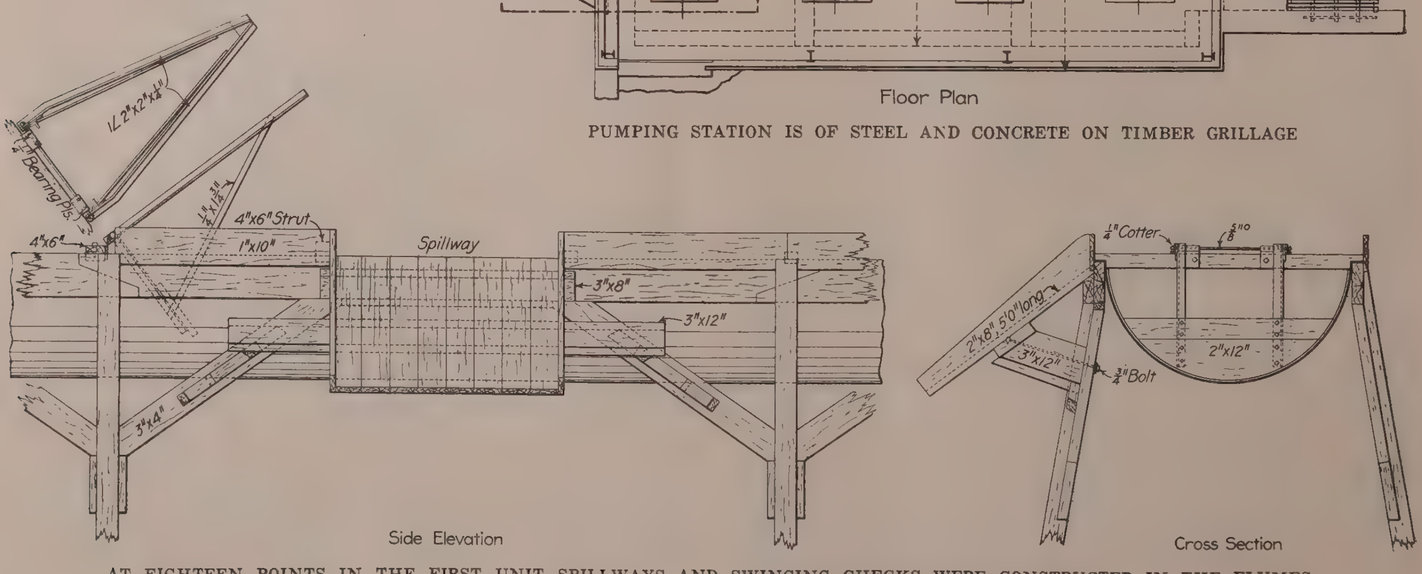
Connection to the three wood-stave pipe lines at the pumping station was made by an 8-in. sleeve riveted to the outside of the steel header, a 2 x 1½-in. bent and welded bar intervening so as to form a socket to receive the staves. The bar was double calked and the wood-stave pipe was calked with pitch and oakum.

The three pipes are 1340, 2290 and 2980 ft. long. They are laid in the same trench on 7-ft. centers and have a minimum cover of 1½ ft. No unusual features were encountered in laying the pipe, which was built by the Portland Wood Pipe Company. At the outlet end each pipe discharges into a concrete head opening into the main canals. Details are shown of the heads with the accompanying weirs for calibrating the pumps and back pressure checks to prevent influx of water down the pipe in case of storms during shut downs for repairs to pipes or pumps. Screens of 2-in. mesh are provided to keep out animals when the pipe lines are not in use.

The canals were built on a grade of 2.112 ft. per mile, starting from the ends of the pipe lines at the three levels and following their respective contours around the valley. These various elevations were chosen to get an equal acreage under each of the three

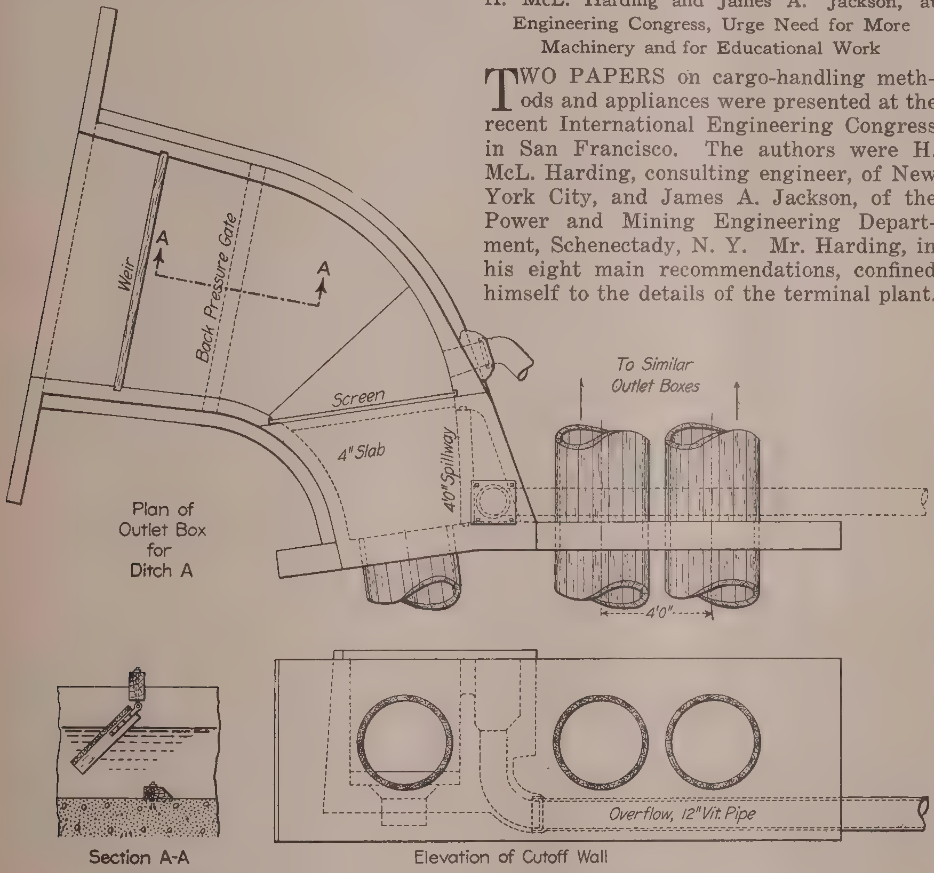


PUMPING STATION IS OF STEEL AND CONCRETE ON TIMBER GRILLAGE



AT EIGHTEEN POINTS IN THE FIRST UNIT SPILLWAYS AND SWINGING CHECKS WERE CONSTRUCTED IN THE FLUMES ditches. On them are 2280 ft. of semicircular Toncan metal flumes over ravines, each provided with a steel inlet and outlet of No. 20 gage metal. At eighteen points spillways and swinging checks were constructed in the flumes as shown in one of the drawings. The remaining overflows and checks were of the ordinary wooden type. All main canals are in unlined earth excavation. The farmers' turnout gates are of concrete and steel, the water being taken through the canal banks in tile pipes, there discharging into wood measuring boxes provided with weirs and control gates. Measurement of all water pumped is made at the outlet of each wood-stave pipe.

The canals were designed after the Kutter formula, with $N = 0.035$, the velocities for the unlined sections being kept below 1½ in most instances. The flumes, the longest of which was 272 ft., spanning a ravine at an elevation 20 ft. above ground, were figured to have a carrying capacity based on $N = 0.012$ in the Kutter formula.



MEASUREMENT OF ALL WATER PUMPED IS MADE AT THE OUTLET BOXES

### AUXILIARY PLANT

During 1914 an auxiliary plant having a capacity of 75 sec.-ft. was installed to irrigate an additional 3500 acres of land to the east and south of the original project. This plant contains two Worthington centrifugal pumps direct-connected to General Electric motors. The pumps discharge under an average head of 160 ft. into a steel header, and this in turn into a wood-stave pipe line which conveys the water to a point where it is discharged into a 9-mile earth canal delivering water throughout its entire length to lands on Spokane Bench. The main plant, together with the auxiliary plant, has been in operation during the 1915 season with marked success, according to the engineers, who also state that the project has demonstrated that irrigation water for grain and forage crops can be pumped 150 ft. high and still be a commercial success.

All metal flumes were furnished by the Enterprise Sheet Metal Works, of Billings, Mont. Boomer & Hughes of Spokane, Wash., excavated the canals by slip scrapers and fresnos. The plant and works were designed by M. H. Gerry, Jr., consulting engineer, of Helena, Mont., and were constructed under his direction. A. W. Verharen was resident engineer in charge of work in the field. The property is owned by the Montana Reservoir & Irrigation Company, which is affiliated with the Montana Power Company.

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# How to Make Cargo Handling More Efficient

H. McL. Harding and James A. Jackson, at Engineering Congress, Urge Need for More Machinery and for Educational Work

TWO PAPERS on cargo-handling methods and appliances were presented at the recent International Engineering Congress in San Francisco. The authors were H. McL. Harding, consulting engineer, of New York City, and James A. Jackson, of the Power and Mining Engineering Department, Schenectady, N. Y. Mr. Harding, in his eight main recommendations, confined himself to the details of the terminal plant. Mr. Jackson laid great stress on the need for educational work and scientific investigation, through technical committees and the machinery manufacturers. He also recommended electric machinery to relieve the immediate needs.

### THE TERMINAL PLANT

Mr. Harding's recommendations were as follows:

1. On the ship there should be at least two double winches for each hatchway, and sufficient booms for burtoning the load, simultaneously, either upon the shore or upon lighters.

2. On the quay or piers there should be traveling gantry jib-cranes, one for each 100 ft. of linear frontage, spanning two or three railway tracks, which tracks are located between the shed and the quay wall.

3. Within the shed there should be overhead movable cross tracks connecting with fixed side tracks, so as to assort and distribute the freight and serve every cubic foot of space (tiering) by a continuous succession of movements, without rehandling and without using floor space; and, also, so as to afford a short path across the shed from the vessel on one side of the pier to another vessel on the other side.

4. The freight should be moved without congestion or delay, by burtoning between the hooks of the gantry cranes or of the ship's winches and the hooks of the traveling hoists.

5. Freight should be transfered between the shed and any floor of a warehouse by one direct movement of the gantry cranes.

6. To secure the greatest rapidity and economy in the above freight movements, the design of the ship and the plan and layout of the elements of terminals should receive careful study.

7. For bulk material the mechanism should be able to reclaim as well as store, and to distribute at a considerable distance from the quay walls.

8. To obtain the greatest return from investments in ships and terminals, the latest mechanical appliances should be installed for speed and economy of transference and handling.

### EDUCATIONAL WORK AND INVESTIGATION

To bring about the best ultimate solutions of the various problems of cargo handling, Mr. Jackson made the following suggestions:

The complete mechanizing of such an immense, cumbersome business as cargo handling must necessarily take time, study and expense. Co-operation and system are essential, in order to reduce these factors to a minimum. At present the few interested parties seem to be working along different lines, as individuals. These facts have been kept in mind by the writer in making the following suggestions:

1. The appointing of committees on mechanical cargo handling by the various interested engineering, architectural, naval and marine societies. Such committees could do much educational work which would stimulate interest by encouraging papers on the subject, to be presented before the societies. Such papers would lead to investigations, tests and a closer study of actual conditions.

2. A committee of naval architects to study the design of ships, with special reference to rapid loading and unloading of cargo. The improvement in the design of bulk freight vessels would indicate that much could be done to improve vessels for miscellaneous freight, if given due consideration. A radical change in design may be in order, as indicated by one vessel recently launched, and one completely designed by a naval architect on the Pacific Coast but not built. The vessel launched is a bulk freighter with a complete self-contained conveyor-type unloader, which completely unloads the entire cargo, with no manual labor, and deposits it on a stock pile on shore. The second vessel is equally well adapted to bulk or package freight. Her freight is loaded into barges, which are floated into the boat through hinged gates in her bow, after which the gates are closed and the water is pumped from her ballast tanks until the barges rest on sills in her hold.

3. A committee of pier and wharf engineers to study the design of piers especially adaptable to the use of machinery. Existing piers are poorly adapted to the use of

machinery, and such points as ratio of length of dock space to pier capacity, in square or cubic feet, seem to have been given very little consideration. Some piers lately built have berth space for ten 10,000-ton ships, and a floor space capable of holding about one and one-half ships' cargoes. Machinery might make a two or three-story pier feasible and economical.

4. The possibility of using wet docks, where tidal conditions are bad. Wet docks, with the help of ballast tanks and pumps aboard ships, would hold a vessel at a constant height, regardless of tide or load, and under this stability, some type of conveyor might be used from the hold to the pier. A conveyor is the ideal machine, as it keeps freight flowing in a stream, with no abrupt changes in handling, and its speed can be so adjusted that it is actually a reservoir in itself, which prevents freight from piling up.

5. An investigation of the situation by municipal, State and National governments. Governmental departments already exist which should consider such investigations their legitimate duty, on account of the vital interest of the public at large in this problem. Port cities should strive to make their municipally owned piers the acme of perfection, thus setting an example which private corporations would soon follow.

### Electric Machinery Recommended

The following suggestions were made by Mr. Jackson with the view of relieving the immediate situation:

1. The use of electrically operated portable winches, controlled by portable controllers and driven by power from the pier. The advantages of this scheme are: (a) Constant source of power, as it would be entirely independent of the ship's boilers; (b) the portable controller makes load visible to operator at all times, this preventing loss of time and the danger of signaling; (c) the winchman gets familiar with his equipment, instead of having to get accustomed to a different winch with each ship; (d) the winches, being owned by the stevedores, could be kept in first-class condition. Ships' winches are often in bad repair and time is lost making them operate satisfactorily.

2. The use of electrically driven portable conveyors and stackers, for unloading, distributing and piling where conditions permit.

3. The use of storage-battery operated trucks, truck cranes and tractors for distribution of cargo.

4. The efficient lighting of piers, wharves and docks.

5. The employment of trained engineers to supervise and direct the handling of freight.

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Rail-Failure Statistics for the year ended Oct. 31, 1914, are tabulated in the September *Bulletin* of the American Railway Engineering Association. As a general average the failures per 10,000 tons of Bessemer rails were about double those of open-hearth rails. A table is given showing the ranking of the mills as regards rate of failures for the rollings of the years 1909, 1910, 1911 and 1912, and a comparison with last year's statistics indicates, as a general average of all of the mills, a gradual decrease in the rate of rail failure of rollings for the successive years since 1908, with which year's rolling the records started.

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# How Australia Builds Its Railroads

## Maurice E. Kernot Tells International Engineering Congress Why Direct Labor Has Supplanted the Contractor for Government-Owned Lines

SIDELIGHTS on Governmental procedure in railroad construction in Australia were given by Maurice E. Kernot, chief engineer for railway construction, Victoria, Australia, in a paper presented at the recent International Engineering Congress. Formerly the work was done by large contracts, but in the last generation the direct-labor method has largely supplanted the contract method, and is believed to have the advantage of both time and cost. Following are extracts from Mr. Kernot's paper, together with a diagram he presented of his organization.

Ninety-eight per cent of the railways in Australia are owned by the Governments of the States and Commonwealth, and a similar percentage of the construction in progress is being carried out by the same public authorities.

Two principal methods are followed in carrying out railway construction, viz., (1) Large contracts, and (2) direct labor. The large-contract method was the general one from 1854, when railway construction in Australia commenced, till 1892. Since then it has given place largely to construction by direct labor.

### Contract Work

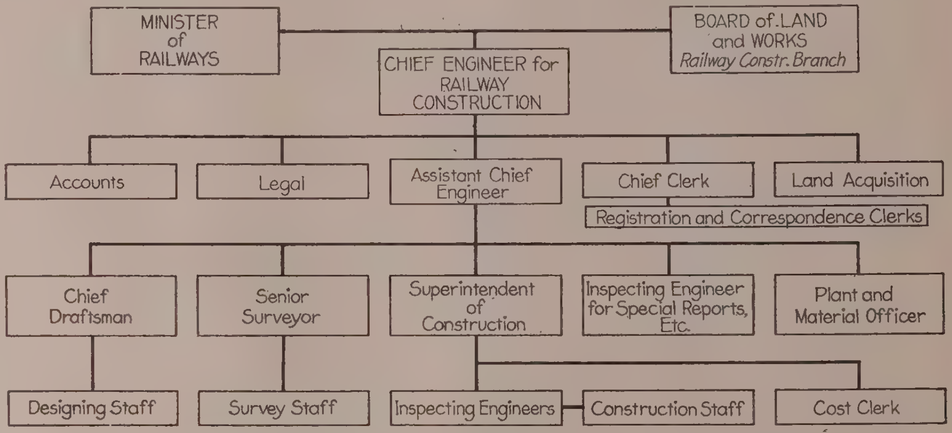
On contract work a money deposit of 5 per cent on the total contract amount, as arrived at from the estimated total quantities of work and the contract rates, is required, and 10 per cent of the value of work done to date is held back from progress payments as further security for the satisfactory completion of the contract, until the amount held is sufficient to give full security for satisfactory completion.

The conditions of contracts generally throw all risks on to the contractor, and give the constructing authorities very full powers for making alterations and additions to the work. Specifications are usually couched in general terms, and only in the case of small contracts do they describe the work in detail.

### Errors in Arithmetic Frequent

The schedule to the contract shows the actual quantities of work required to be done as shown on the plans, sections and drawings, which form part of the contract. The number of items in the schedules is large, it being common practice to schedule all main-line cuttings separately and also all stuff required to complete each separate embankment, and many contractors quote separate prices for each. In this way the number of items in the schedule often runs up to more than 1000. As a consequence of the large number of items in the schedule, and the hurry with which contractors usually complete their tenders or bids, mistakes in arriving at the total amount are often made. It is the practice to keep a contractor to the amount shown at the foot of his tender, and require alterations in prices to adjust errors in arithmetic.

Tenders may be submitted by anyone, without restriction, so long as the proper deposit of money is made along with them; and the practice is to accept the lowest tender, it being assumed that all contractors are of equal merit, unless they have been formally disqualified, which is very rarely done.


MINISTER of RAILWAYS
BOARD of LAND and WORKS Railway Constr. Branch
CHIEF ENGINEER for RAILWAY CONSTRUCTION
Accounts
Legal
Assistant Chief Engineer
Chief Clerk
Land Acquisition
Registration and Correspondence Clerks
Chief Draftsman
Senior Surveyor
Superintendent of Construction
Inspecting Engineer for Special Reports, Etc.
Plant and Material Officer
Designing Staff
Survey Staff
Inspecting Engineers
Construction Staff
Cost Clerk

ORGANIZATION OF GOVERNMENT RAILROAD CONSTRUCTION DEPARTMENT

Contractors often adjust the prices in their contracts, thus speculating on the probability of the quantities shown in the schedule being exceeded or diminished, and also with the idea of getting in their profits chiefly from the items of work which have to be first carried out, and so practically having a set-off against their money deposit. The conditions of contract give power to the chief engineer to insist on adjustment of unreasonable prices, or he may make a deduction from payments to protect the constructing authority.

The critical item of railway construction contracts is usually that for ballast, and the question whether the contractor shall make large profits or lose money on his contract often hangs on the opinion of the chief engineer as to whether ballast from a certain source complies with the specification.

### Delays

In carrying out the contracts there is often much delay, as contractors think it pays them to wait over wet seasons or for a fall in market prices of materials, and take their chance of obtaining a remission of penalties for delay. In actual experience the penalties have seldom been enforced, and the effect on contract work has been bad.

It has been the general practice to provide for a settlement of disputes which arise in settling up contracts by arbitration. The results of arbitration have been unsatisfactory. Contractors in many cases took up railway work at non-paying prices, either through ignorance of the value of the work or in the hope of making up losses by claims for extras and concessions. In such cases, and in many others where the contractors had good prices, enormous claims for extras and allowance were made, and very heavy expenses were incurred in investigating or resisting and contesting such claims, and very large awards were in many cases made in favor of the contractors by irresponsible arbitrators.

### COSTS OF ARBITRATION

In Victoria alone in a period of ten years seventeen contracts for 384 miles of railway, aggregating a cost of $6,340,339 under the chief engineer's final certificate, went to arbitration. Extra claims amounting to $1,999,651 were made by the contractors, on which the arbitrators awarded $537,566. The expenses incurred and paid by the constructing authority in addition came to $144,000.

An appeal to the Supreme Court was also made by contractors on the ground that the powers given to the chief engineer by the conditions of contract were excessive and inequitable, but the court held that when a contractor had signed the conditions with his eyes open he was bound to them. In recent years the chief engineer has, in some cases, been made sole arbitrator, and this practice has, on the whole, worked well. The chief engineer, in such cases, holds himself aloof from direct supervision of details of the contract.

### DIRECT LABOR

The difficulties and large expenses incurred in the settlement of contracts, the frequent long delays in completion of contracts, the desire to obtain more economical railway construction, and the wish to start work promptly in time of depression, when large numbers of unemployed men are in want of work, led to the introduction of the direct-labor system in Victoria in 1892, and since that date it has been used for all railway construction in Victoria, and largely followed in the other states of the Commonwealth, where, however, the practice has oscillated between the two systems—large contracts and direct labor—with a gradual increase in the proportion of direct-labor work.

The following notes apply particularly to the working of the direct-labor system of construction in the State of Victoria.

All expenditure is charged directly to the money voted for the particular line. A strict continuous audit is made by an outside auditor.

All the work has been completed to the satisfaction of the railways commissioners in whom the lines are vested for operation on their completion, except in one case where the estimated cost had been cut down by Parliament against the advice of the chief engineer.

### TESTS OF SYSTEM

This system has been tested on two occasions by calling for tenders or bids for 30-mile sections of construction. On the first occasion the lowest tender received was 10 per cent higher than the departmental estimate. It was rejected and the department carried out the construction of the line by direct labor, and finished it at a cost below its own estimate. In the second case, a tender was received which was 1¾ per cent lower than the departmental estimate, but after investigation it was decided not to accept the tender, and the line was built by direct labor at a lower cost than if the contract had been accepted.

In carrying out work under the direct labor system, an engineer is placed in control of the job, with suitable assistants, including a pay clerk, who acts as his accountant and is directly responsible to him, while he is responsible for the whole of the work, including all money payments made on the job. His duties thus cover a large scope, as he is manager of the work as well as engineer, and great care has to be exercised in selecting new men for the positions.

In employing workmen it is usual to put on suitable men who make application on the spot. Experienced railway workers find their way to new works in considerable numbers. When, however, the supply of these is not sufficient, requisitions are made on the Government Labor Bureau.

The men are provided with tents and cooking utensils, for which they have to pay in installments. Laborers have to pay for their own shovels, and tradesmen have to provide their own small tools or pay for them; other tools are provided by the department. The tents and tools supplied are not taken back from the men, except in cases where they leave before they have earned sufficient money to pay for them.

### PIECEWORK AND GANG WORK

Piecework is used as far as it can be applied to advantage. Simple work, such as barrow-led earthwork and bridge carpentry, are done by gangs working at fixed rates, while work requiring the use of horses and plant is generally let in petty contracts made locally with men on the works. The pieceworkers and petty contractors sign a simple form of contract, which gives power to the engineer in charge to stop the work at twenty-four hours' notice for any good reason.

When a local contract is taken up by one man, who employs other men, the form of contract provides further that his employees are to be paid directly by the department at standard wage rates, and the amounts of such payments are deducted from the amount coming due to the contractor. Offers to carry out work at prices so low that there is no reasonable prospect of the contractors' earnings being sufficient to pay standard wages are rejected.

Fixed rates are arranged at the head office and are adjusted from time to time so that efficient industrious men may make standard wages or a little more. Piecework men who fail to make earnings up to standard wage rates after a fair trial, and wages men who fail to work efficiently, are promptly dispensed with, the aim throughout being to pay prices which are fair both to the worker and the employer and to get a fair day's work for the day's pay.

There is an increasing tendency to do more of the work with gangs employed on day wages. These gangs, when under the control of capable gangers, working under effective supervision, and with a regular weeding-out of men who do not work efficiently, do good work, and, in many cases, do the work at rather less cost than pieceworkers.

### TIME-KEEPING AND PAYMENT

All the work, whether done by the piece, by contract, or by day labor, is measured up fortnightly and the costs compared with other work, so that inefficient gangs may be promptly dealt with.

A thorough system of time-keeping is kept in operation, and includes the apportionment of the time to the different items of work in a rather elaborate schedule of apportionments, including sufficient information for an analysis of costs. The workmen are paid fortnightly.

The staff in charge of a construction job is provided with quarters in temporary buildings and tents, and the department provides the cook and mess equipment. In return for these concessions, the members of the staff are required to be available at any hours which the engineer in charge may desire, but any officer who is kept on duty over an extended period for long hours can apply for and be allowed time off in consideration. The organization of the staff is shown in the accompanying diagram.

### TWO MAIN ADVANTAGES OF DIRECT-LABOR SYSTEM

The direct-labor system has shown the following advantages:

1. *A saving in time.*—The period required under the old contract system for completing surveys, plans, quantities, specifications and drawings, advertising and letting contracts, which extended over many months, has all been saved, and the expense so incurred largely reduced; also, the actual work of construction has been carried out, on the average, in about two-thirds of the time taken by contractors. Work is often started on the heels of the surveyors who locate the line.

2. *A saving in cost.*—Instead of a contractor paying a staff to carry on the work, while the department paid another staff of officers and inspectors to supervise them, one staff under the department now does all the work, while the workmen do the work as well and as cheaply for the Government as for a contractor, when properly handled.

The contractor's financial and commercial arrangements were often badly made and caused loss to him, and loss and trouble to the constructing authority. The percentage included in the contractor's prices to give him a profit is saved. Money with which to carry on the work is obtained by the Government at half the rates of interest which contractors often pay.

The heavy claims which were made in connection with large contracts and only settled with great expense and trouble, often by tedious and costly arbitration, are quite avoided.

Partial stoppages of work, shifting of station sites, and alterations of design, which usually led up to the large claims, are now made more freely and, in most cases, have only small effect on the cost of the works; while other unforeseen contingencies are dealt with promptly and easily. Full advantage is taken of cheaper materials discovered when carrying out works, and of fluctuations in market rates. Modifications in design and execution are freely introduced when economy or efficiency may result. Contractors, when tendering, had to make large allowance for providing plant, including locomotives and trucks, which might be left idle on their hands, with poor opportunities of realizing at reasonable prices, and, in many cases, made shift with very inferior wasteful plant in consequence. Under the direct-labor system, all construction in the State being done by one party, better plant is provided and it is more regularly utilized, the cost for any individual line being thus largely decreased.

### Other Advantages

Another advantage of the direct-labor system is that it has been possible to distribute employment systematically and fairly among the unemployed workers of the State, and also to secure payment of standard rates of wages without the difficulties which have occurred in enforcing the minimum wage clauses under contracts.

Generally speaking, the men have worked contentedly. Complaints from them have been fewer than might have been expected and have been fairly met and dealt with. In twenty-three years there has not been one large strike, and occasional small ones have been handled easily till they fizzled out.

In comparison with contract work, the department officers may not have the stimulus of increased profit to urge them on to strict economy and keep them keen in reduction of costs, but with diligent effective supervision and control by competent officers, the efficiency of working is little, if any, behind the average of contract work.

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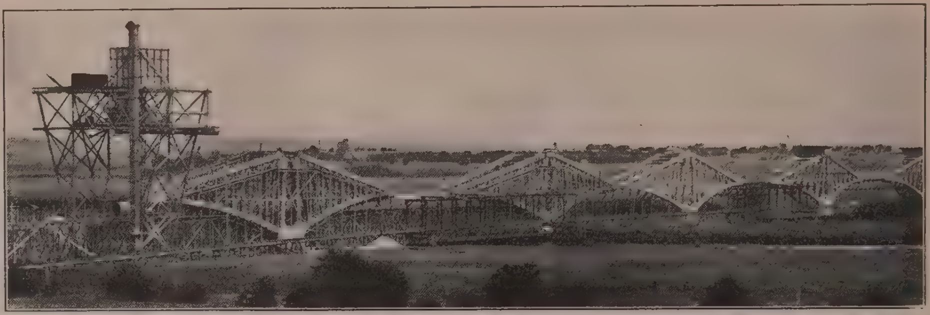
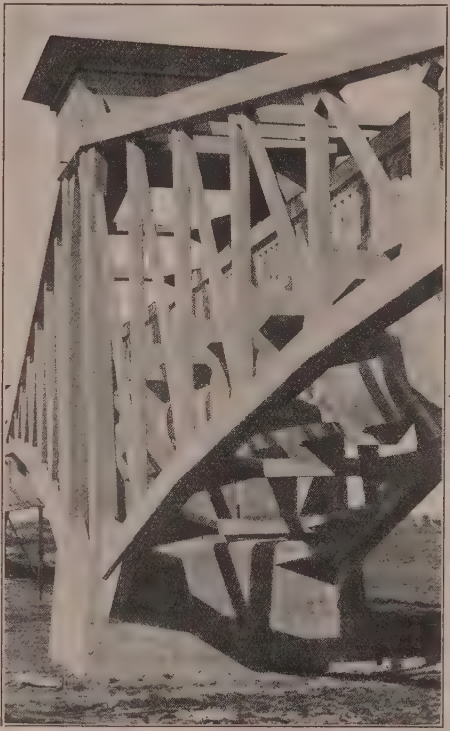
## Concrete Cantilever Trusses Support Large Pipe Line

Structure 2424 Feet Long Carries Sewer Across Barwon River in Australia—Footpath with Girder Handrails a Feature

FURTHER EVIDENCE of the possibilities of reinforced-concrete construction is strikingly offered by the new cantilever truss design for carrying a reinforced-concrete sewer over a crossing nearly half a mile long of river flats in Australia. The accompanying illustrations give an idea of the unusual character of the structure. It is located in Victoria, Australia, and was adopted after alternative designs in both steel and reinforced concrete had been made to carry the sewer, which is part of the recently installed sewer system of Geelong across the River Barwon and the river flats.


FALSEWORK CONSTRUCTION AND TRAVELING CONCRETING PLANT

The total length of the structure is 2424 ft., consisting of thirteen spans of 176 ft. and one span of 136 ft. The suspended spans are 40-ft. girders, free to move at one end. The cantilever design is economical and has a further advantage in the fact that all temperature variations can be provided for by horizontal movement at expansion joints. This consideration ruled out the possible alternative of a series of arches, in which temperature movements are vertical and would create a series of undulations very undesirable, because the grade of the sewer is only 1 in 2500.


SPREAD OF CANTILEVERS GREATER AT PIERS THAN AT ENDS

### Cantilever Trusses Spread Toward Piers

The distance between cantilever trusses is increased toward the piers in order adequately and economically to resist the horizontal wind forces. The lateral bracing consists of transverse struts with knee braces to the main chords, as seen in the photographs.

The reinforced-concrete pipes are oval in form and cast in 8-ft. sections, which correspond to the 8-ft. panel lengths of the trusses. Cross beams and struts thus support the pipes at their joints. The same forms were used for the pipes on the structure as for the main sections of the sewer.

### Tensile Reinforcement of Plain Rods

The reinforcement throughout is of ordinary steel rods, the full tensile strength being developed at the splices by laps; in no case are they mechanically connected. The rods in the upper chord are arranged in concentric rings, the laps of which break joints along its length. The diagonals are in tension, and the ends of the rods through them are accurately bent around the rods in the upper and lower chords.

A footpath is provided throughout the whole length, and the details of its treatment add very considerably to the appearance of the work. The handrailing of the footpath is sufficiently reinforced to act as a girder. It was thus possible to maintain a continuous footpath form.

The structure was designed and constructed by Stone & Siddeley, reinforced-concrete engineers, of Sydney, Australia, for the Waterworks and Sewerage Trust of Geelong, of which R. T. McKay is chief engineer.

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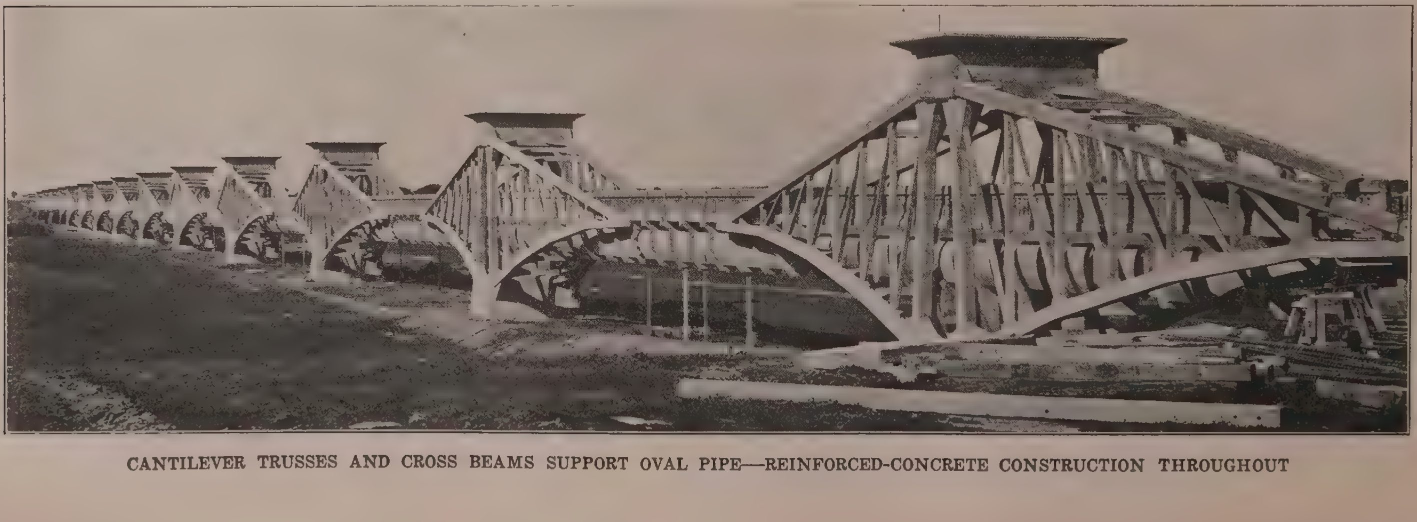
Arkansas Has 36,000 Miles of public roads, with less than 1000 miles, or 3 per cent, of them improved. Since the inauguration of a State highway commission in 1913 plans have been prepared by that body for work costing $2,315,366. In 1914, states H. R. Carter, State highway engineer, in his first biennial report, about 93 miles of roads were constructed under the supervision of the highway department at an average cost of $5,300 per mile.


CANTILEVER TRUSSES AND CROSS BEAMS SUPPORT OVAL PIPE—REINFORCED-CONCRETE CONSTRUCTION THROUGHOUT

# Automatic Siphons Used in Italian Dams

Satisfactory Service of Many Years Proves Efficiency of Unusual Construction Which Replaces Ordinary Spillways

ITALIAN irrigation was discussed in a paper presented at the International Engineering Congress by Prof. Luigi Luiggi, inspector general of engineers and professor of hydraulic engineering at the Royal University of Rome, Italy, which contains the following illustrations of unusual arch construction and the use of automatic siphons. Other examples of European siphon installations have been given in an article by A. G. Hillberg in the Engineering Record of May 3, 1913, page 488.

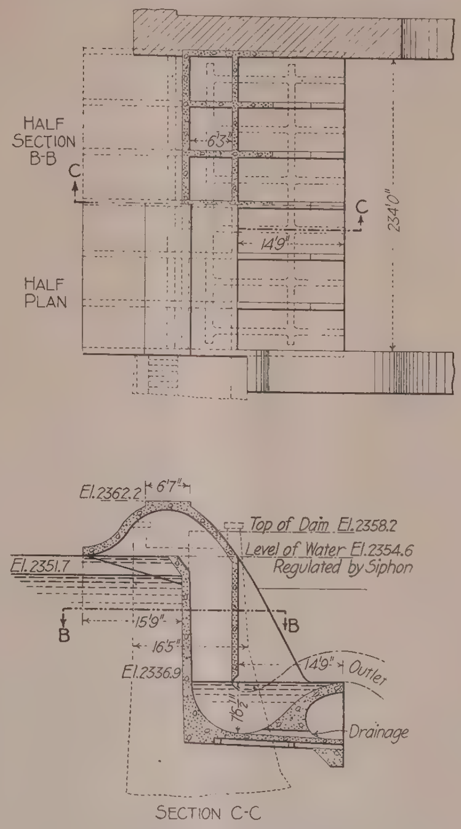
### ARCH DAM AND AUTOMATIC SIPHONS

An interesting dam, very daring in design, and with a cross-section similar to the Bear Valley dam in California, is the Corfina dam shown in one of the accompanying drawings. It is not a gravity dam, but an arched dam 116 ft. high, of the dimensions given, and with a radius of only 75 ft. It was built in 65 days by pouring the 1:2:4 concrete, mixed rather wet, into wooden molds. It gave very good results, technically and financially. The cost was only $30,000 and the unit cost only 12 cents per 1000 gal. of storage capacity.

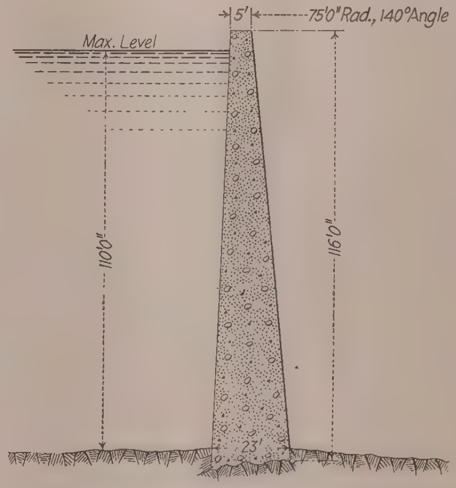
The most important group of dams, five in all, just finished on the River Gorzente near Genova, included the Badana dam. This dam is 188 ft. high, at present the highest in Italy. It is 715 ft. long at the crest, contains 132,000 cu. yd. of masonry, and cost approximately $465,000, making the unit cost 45 cents per 1000 gal. of storage capacity.

A special feature of the dams of this group is that the flood-water is not discharged over the usual overflow spillways, but by means of a series of automatic siphons. In the Badana dam are six siphons with a total discharge of 3150 sec.-ft., with dimensions as shown on the drawing. In the Lagolunge dam there are ten siphons. This is, perhaps the largest group of automatic siphons existing. They have given excellent results for several years.

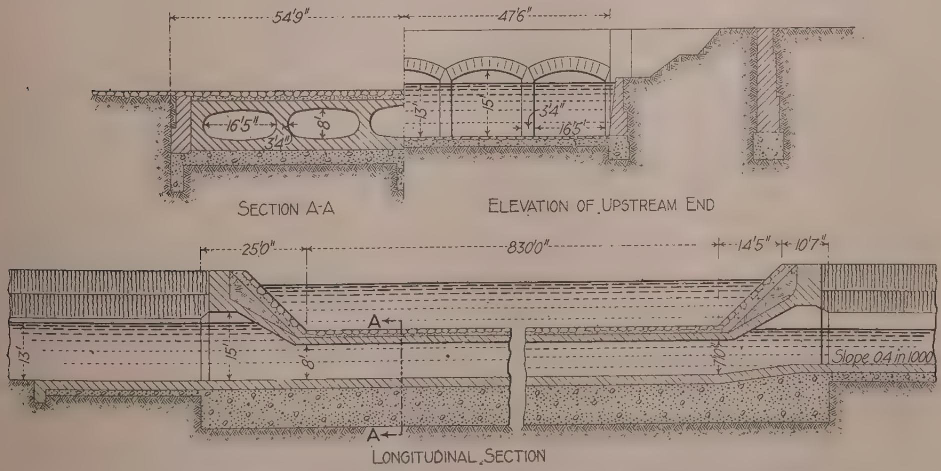
The inverted siphon of masonry under the River Sesia on the Cavour Canal, which discharges 3884 sec.-ft., is another example of unusual construction. The dimensions and general outlines of this five-way siphon are shown on one of the accompanying drawings.



SIX SIPHONS IN BADANA DAM



HIGH CORFINA DAM OF ARCH TYPE



INVERTED SIPHON OF MASONRY UNDER RIVER SESIA ON CAVOUR CANAL

# California Commission on Four Valuation Questions

Purpose of Utility Irrelevant—Rate More Than Traffic Will Bear—Contracting Away Rights —Actual Land Multiples Not Allowed

FOUR DECISIONS involving minor valuation questions were handed down by the Railroad Commission of California in October. Summaries of them are here presented, not because of any connection with one another, but because they deal with questions that may be raised anywhere. In one case the fact that a utility was built to enhance the value of property which was subsequently sold at a considerable profit was held to be insufficient ground for denying the utility a fair return. In the second, contrariwise, it was held unfair to compel a meager consuming population to support by high rates an expensive plant. In the third case a contract between utility and municipality for service at a certain rate was held as not eliminating the jurisdiction of the commission. In the fourth, the reproduction cost of a railroad built five years ago was found to be less than the original cost, mainly because a smaller multiplier for the land is allowed than was actually required.

### PURPOSE OF UTILITY IRRELEVANT

In the first case the Sweetwater Water Company had applied for authority to raise its rates in unincorporated territory, contending that under the existing schedule its revenues were insufficient to provide operating expenses and a fair return on the value of the system. The application was opposed on the ground that the water system had been constructed solely to enhance the value of the property it served, and that this property was later sold at a considerable profit. The commission ruled that this contention was not pertinent—that profits made on realty could not be considered as detracting from the value of the water plant, and that the system was still entitled to a return on the reasonably useful value, excluding unnecessary extensions.

### MORE THAN THE TRAFFIC WILL BEAR

Contrasting with this case is that of the Sacramento Valley West Side Canal Company, an irrigation company having an expensive initial plant with as yet few consumers. The company had contended that the existing rates were insufficient to earn a fair return over and above operating and maintenance expenses and an allowance for depreciation. The commission held that while this matter must be considered, the reasonable value of the service to the public must also be taken into account, and in this case the small number of consumers could not be expected to pay higher rates than surrounding communities paid for the irrigation of identical crops. The company's predicament, the commission held, was merely typical of that of irrigation companies in their first years of operation. Quoting from the commission, "If attempt were made to apply the principle urged by petitioners herein, the rates would be so high that nobody could afford to buy land in the project and hence the project would permanently be deprived of an opportunity to make good."

### TOWNS MAY NOT CONTRACT AWAY RIGHTS

The question in the case of the town of Sausalito vs. Marin Water & Power Company was one of the jurisdiction of the commission. The town entered into a contract with the company to secure water in wholesale quantities for ten years dating from Aug. 1, 1909. The town now contends that the rate is unreasonable and discriminatory, and desires the commission to establish a reasonable rate. In the proceedings just concluded the company claimed that as the town had the right to enter into the contract, and did enter into it voluntarily, the State could have no jurisdiction in the matter during the life of the contract. The commission finds otherwise, however, and quotes numerous court decisions in support of the ruling. The finding does not in any way pass upon the reasonableness of the rate.

### ACTUAL LAND MULTIPLES NOT ALLOWED

Actual multiples entering into the land costs of the Quincy Western Railway, built in 1910, are not allowed in the reproduction cost reached by the commission in an investigation made on the commission's own initiative. The commission holds 1½ to be a high enough multiplier, although the company actually paid on the basis of 3. As a consequence the reproduction cost of the 5-mile line is less than the original cost.

Commissioner Loveland, who wrote the opinion, makes no accusation of extravagance or bad judgment in the purchase of the land, but states that "owing to the peculiar conditions arising at the time the right-of-way was acquired the company was forced to pay an abnormally high price for lands purchased, and accordingly asked that in determining reproduction cost a multiple of 3 be allowed." In the same paragraph he says: "Under the heading of 'reproduction cost' it is necessary to determine the present value of these railroad lands, and the question arises if this present value should be the same as the present market value of adjoining and similar lands, or if a special and higher 'railroad value' attaches to lands owned by a common carrier. If the latter alternative is allowed, as constantly insisted upon by railroad companies, the multiple theory is appealed to. . . . I am ready, however, to say now that if a multiple be allowed, it should be determined on the basis of actual present-day average conditions, and I can see no reason whatsoever why in this case present-day land values should be multiplied by 3 simply because at the time of the original purchase of the land the carrier found it necessary to pay so largely in excess of the actual values."

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# Large Frog and Switch Plant at Easton Built in Practically One Year

### New Works of Wharton Company Occupy 25 Acres, Replace Three Former Plants and Were Designed with Special Attention to Facility of Operation

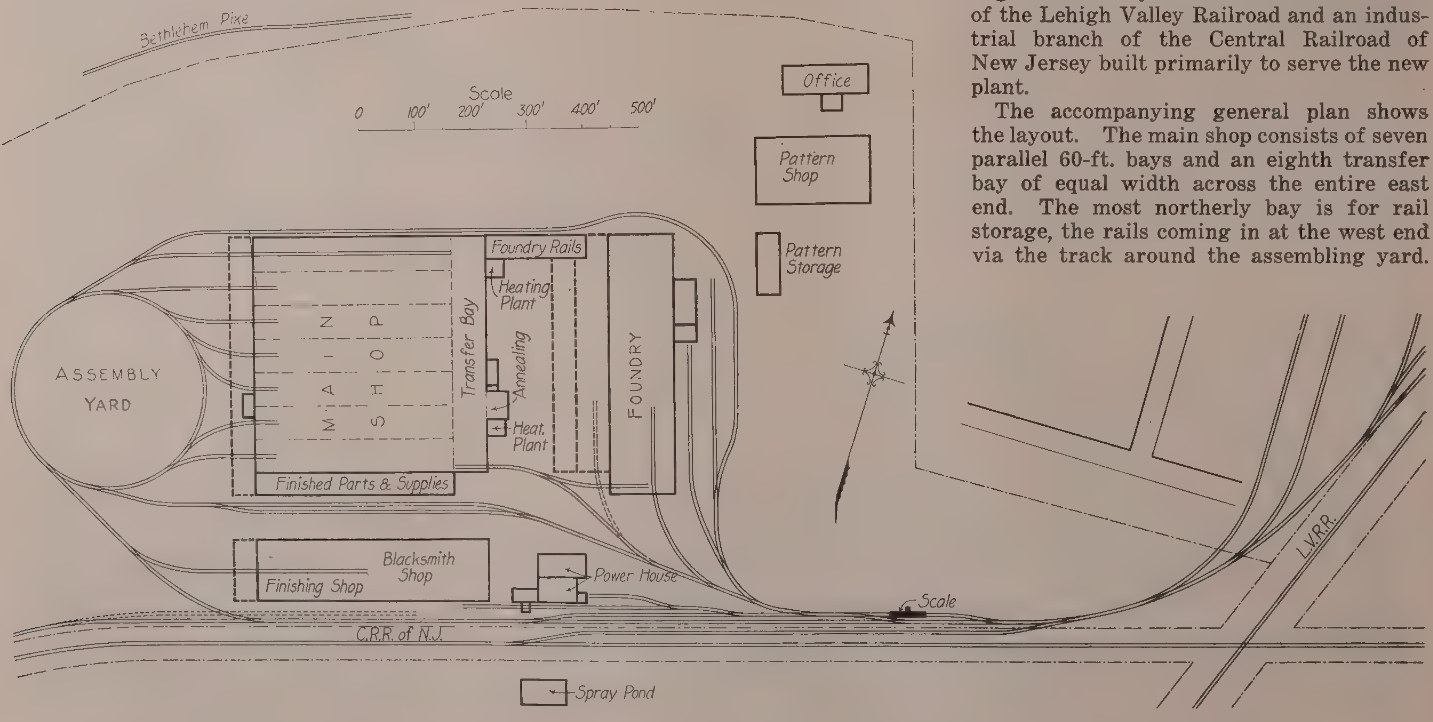
A MAIN SHOP 420 ft. square, exclusive of various annexes, a foundry 115 x 460 ft., a blacksmith shop 110 x 420 ft., and a storage yard inclosed by a circular track of 175 ft. radius are the chief elements of the new plant, just put into operation, of William Wharton, Jr. & Company, Inc., manufacturers of frogs and switches, at Easton, Pa. Great care was exercised in the design of the layout to facilitate the different sequences of operation of the plant and minimize the moving of heavy parts. Among the engineering features may be mentioned the complete sewer system, including a septic tank; the high foundation pedestals for the buildings on filled ground, built prior to the filling; the smooth-face tile exterior walls laid in cement mortar colored to match the tile, and the wood-block floors, in which the "sweating" of the creosoted blocks was utilized to bond the blocks together.

FOUNDATION PEDESTALS OF MAIN SHOP BUILT IN ADVANCE OF GRADING

### THE PLANT

The plant occupies a tract of some 50 acres, about half of which has been graded for present needs. It replaces the company's plants at Philadelphia and Jenkintown, Pa., and also that of the Tioga Steel & Iron Company at Philadelphia. It is located about 2 miles west of Easton, in an angle formed by the intersection of lines of the Lehigh Valley Railroad and an industrial branch of the Central Railroad of New Jersey built primarily to serve the new plant.

The accompanying general plan shows the layout. The main shop consists of seven parallel 60-ft. bays and an eighth transfer bay of equal width across the entire east end. The most northerly bay is for rail storage, the rails coming in at the west end via the track around the assembling yard.



LAYOUT WAS DESIGNED TO FACILITATE SEQUENCE OF OPERATION WITH MINIMUM MOVING OF HEAVY PARTS

Small parts, such as bolts and nuts, come in via the stock-room siding, and are stored in the east end of the stock-room, whence they pass into the main shop. The west end is used for storage of small parts ready for shipment. Alongside the stock-room is a billet yard, served by a traveling crane for forge shop material. The manganese steel castings which form the bulk of the product of the shops are received on cars on the track which leads into the southeast corner of the main shop, whence they are moved northward along the transfer bay, passing through a specially designed press to bend or straighten them as may be required, after which they are transferred into the grinding department.

### MAIN OPERATIONS

The two main products of the plant are switches and frogs. Work on both starts at the north end of the transfer bay, and the finished parts pass out at the west end into the assembling yard, where they are fitted together and loaded for shipment. The switch rails pass from the saws at the north end of the transfer bay into the split-switch and bending bay adjacent to the rail-storage bay, and from there into the machine shop and out to the assembling yard. The frog and other parts requiring foundry work move to the east, through the foundry-rail annex, into the foundry, whence they come back into the main shop via the track from the south end of the foundry. Hence they have access to any section of the main shop, and when finished pass out to the assembling yard.

In a general way the first bay south of the rail-storage bay is assigned to curved rails and split-switch work; the next bay is assigned to plain bolted frogs and crossings; the next to cast-steel girder and T-rail work; the next to manganese-steel track work; the next to manganese girder-rail work, and the next to cast-iron and miscellaneous track work.

### CRANES

All bays in the main shop are equipped with 5-ton overhead electric traveling cranes, those in the east-and-west bays being so located that they extend on cantilever tracks into the transfer bay for easy transfer of materials. The tools in the shop are also served by traveling jib or wall cranes.

At the northeast corner of the foundry is the pattern shop, and beyond that, fronting on the Bethlehem Pike, is the office building. Between the main shop and the Central Railroad of New Jersey is the blacksmith shop and the power house, while on the opposite side of the railroad is the spray pond, which cools the condensing water and also, with its capacity of 180,000 gal., serves as an emergency reservoir for fire protection. The whole plant is served as shown by a standard-gage industrial railroad connecting direct at various points with the main siding. Macadam roads will connect all shipping and receiving departments with the Bethlehem Pike, and also provide for easy handling of materials by motor trucks between shops.

About 95,000 cu. yd. of grading was required, part of which was in rock. The yard level was fixed to balance the cut and fill and provide easy grades for the railroad tracks. The deepest cut is about 16 ft., while the deepest fill is 14 ft.

With the exception of the office, which is a two-story reinforced-concrete building, all structures are of the one-story, shop-constructon type, with complete skeleton steel frames supported on concrete foundations. The buildings on filled ground rest on high pedestals built in advance of the filling. Above the bases the walls are of 6-in. and 8-in. smooth-face tile laid in cement mortar colored to match the tile, and the effect is very satisfactory.

UPPER AND LOWER VIEWS OF THE MAIN SHOP WERE TAKEN FIVE WEEKS APART, OCT. 23 AND NOV. 28, 1914

### LIGHT AND HEAT

Much attention has been given to the considerations of light and heat. The abundance of large windows and skylights, with the sawtooth roof construction of the main shop, make the buildings, it is believed, unusually light. Heat is supplied by the indirect method. Two plants are arranged to draw fresh air from outdoors or to recirculate in extreme cold weather. Underground ducts supply the heat, the feature being the large number of outlets (approximately every 40 ft. each way). The ducts are of graduated sizes carefully calculated to distribute the heat equally.

The floors of the main shop, foundry-rails annex and finishing end of the blacksmith shop are made of 3-in. longleaf yellow-pine blocks treated by the Rueping process with 8 lb. of preservative oil per cubic foot. These blocks were laid on a pitch cushion on top of a 5-in. concrete base, which was brought to a true surface and mopped with hot pitch, in which the blocks were laid as close together as possible. Slag sand was swept over them and into the joints as the blocks were shrinking, and the "sweating" of the creosote blocks in conjunction with the slag sand, cemented them together. Pitch-filled expansion joints were provided every 60 ft.

### DRAINAGE

The rock underlying the plant is so seamy that once water reaches it it disappears. The surface water of the yard is drained into basins built at these crevices. All buildings are connected with a sanitary sewer which discharges into a septic tank and settling chamber. The overflow of the septic tank leads into a cesspool which extends 40 ft. deep to rock, through the crevices of which the effluent will flow away.

The design and construction of the entire plant were handled by Wesinghouse Church Kerr & Company, of New York City, collaborating with William Wharton, Jr., & Company, Inc., through its vice-president, Victor Angerer, and its general superintendent, A. B. Davenport, Jr. R. A. Marshall was engineer in charge for Westinghouse Church Kerr & Company. Ground was broken for the plant in June, 1914, and partial operation of the plant was begun in July, 1915.

RIGHT — WINDOW AND SKYLIGHT SYSTEM MAKES PATTERN SHOP LIGHT DESPITE WIDTH

LEFT—INTERIOR OF MAIN SHOP, WHARTON PLANT—NOTE CRANE WAYS AND JIB CRANES

## Tearing Up of New Pavements Not Allowed in Springfield

UNDERGROUND utilities are stripped in Springfield, Ohio, before new pavements are laid, and then the pavements may not be torn up for five years. Sixteen blocks of the downtown district, 37,000 sq. yd., have been completed this season in four months, a period two weeks less than called for in the specifications. The pavement is of longleaf yellow-pine wood blocks treated with distillate oil laid on a $\frac{1}{2}$-in. layer of sand over a 6-in. concrete foundation. The time includes replacing the street-car tracks with 100-lb. rails and all manganese steel specials, laid on steel ties embedded in concrete. J. Hanan, Springfield, was the contractor. J. Bahin is city engineer, reporting to C. E. Ashburner, city manager.

SAVANNAH, GA., is the city in which is operated the refuse destructor to which E. R. Conant's data published in the Engineering Record of Oct. 30, page 532, referred. Through an error the location of the destructor was given as Atlanta, Ga.

## Trained Buyers Save Big Sums in City Purchases of Supplies and Equipment

### Fowler S. Smith, Purchasing Agent of Dayton, Tells City Managers' Convention of Economies Possible Under New City Manager Administration

SURPRISING economies in buying municipal supplies can be made by cities if they will devote to the selection and training of their purchasing agents the same intelligence that is displayed by private corporations in developing a sales force. Dayton, under the city manager form of administration, has profited by revising the former clumsy routine of the purchasing agent's office and is now able to stock up when the market is low, buy in bulk for several departments simultaneously and make substantial savings in many other ways. The methods in force were outlined at the City Managers' Convention in Dayton last week by Fowler S. Smith, Dayton's purchasing agent; the following extracts are from his address:

### RANGE OF PURCHASES WIDE

The diversity of the lines to be purchased for municipal use is almost unbelievable—much greater than would be required in any one business. Consider for a moment the ramifications of the work of a thriving, modern city government. There are the fire and police departments; service department with sewers, streets, bridges, garbage and ashes, waterworks and motor vehicles; the welfare department with the health, laboratory, recreation, parks, playgrounds, prisons, hospitals, greenhouses; and besides these there are the special printing, office supplies and equipment for all departments. With the city purchasing agent it is, first, an automobile repair job, next, material for streets, then food supplies or women's stockings for the workhouse or perhaps marbles, jackstones or baseballs for the playgrounds.

### DAYTON'S SYSTEM

The Dayton charter provides that there must be full and open competition on all purchases; that no order shall be issued unless there are sufficient available funds to cover the purchase; that a sufficient sum shall be set aside and held ready to pay the bill when rendered; and that the city manager shall approve every order. Besides fully covering all of these points the system provides a requisition in duplicate signed by division and department heads and inquiry for prices to vendors in such form that specifications and details are identical for all, even as to cash discount and freight or delivery charges. A simple filing system, so that all details on outstanding inquiries and orders are quickly accessible, is kept. A copy of the purchase order is sent to the successful vendor, a copy retained for the purchasing agent's files, and one each forwarded to the city accountant, the requisitioner, and the inspector, all with spaces to record date of delivery, amount received, date of payment, etc. The system requires a force of only two men in addition to the purchasing agent.

### MUST WATCH MARKETS

One place where a city buyer can make a big showing is by watching the markets closely on all lines and buying as nearly as possible at the low point. Very little attention as a rule has been paid in city work to this phase of buying in the past, and yet it is one of the most important things to be done. Dayton purchased cast-iron water pipe at an exceptionally low price by going into the market at the right time, when the iron market was at its lowest point and the pipe foundries wild for business to allow them to keep running. Mr. Smith waited three months after he knew that he would need the pipe until he judged conditions were right. After the purchase was made the market advanced several dollars a ton within two months and as he used 6300 tons, the saving on this one item was sufficient to pay the expenses of the entire division for more than four years.

The city contracted for a year's supply of gasoline on Aug. 1 at 9 cents per gallon, the lowest point in the market. The advance to date has been 4 or 5 cents a gallon and a good prospect of a further advance. As there was used 75,000 gal., the city already is $3,000 ahead. Next spring it is expected to build three bridges which will require approximately 800 tons of reinforcing steel. Instead of waiting to buy when plans are completed and contracts placed, or letting the contractor furnish it at a high price, the city purchased it Oct. 1 and at to-day's market for the same material there is a saving of $2,400, and with conditions as they are at present in the steel trade, Dayton will be $4,000 ahead by the time delivery is needed.

### ELIMINATING "INFLUENCES"

Political and personal influence and still more questionable tactics are often used in the effort to land a big order and the purchasing agent's biggest work, before asking for bids, consists in drawing up specifications which are fair to the bidder and to the city, and in other ways convincing the bidders that the old methods don't go. A large percentage is usually allowed on the prices of these items to cover "selling expense." As no selling expense is possible under present methods in Dayton, Mr. Smith always tries to have the prices cut this amount and has several times succeeded in saving 25 per cent.

Dayton advertises only its larger purchases. The small legal advertisement, Mr. Smith believes, is not seen by twenty people in a daily paper. The city does not require a certified check or bond with bids. All contracts, of course, are secured by bond, but it has been found that a great deal of the dissatisfaction among merchants and dealers with city business lies in the necessity of depositing a certified check. Mr. Smith cannot see where it is any protection to the city and he has received more and better bids since he discontinued the practice.

### SAVING IN COAL

On coal, of which Dayton uses about 10,000 tons per year, the city has been very successful in buying on a B.t.u. basis. The coal is used in two power plants, the waterworks pumping station and the reduction plant, and in stoves and furnaces in the various departments. Contracts are for the coal of various grades, in carloads, f.o.b. cars Dayton, and a separate contract is made to cover hauling to various points. Where formerly coal was purchased from retailers for furnace and stove purposes at $4.75 to $5 per ton, with no guarantee as to quality, the city now buys in car lots and delivers a much better coal, fully guaranteed as to quality, at a price of $2.46 to $2.63 per ton, depending upon point of delivery and hauling charge. Every car of coal is sampled as received; samples are analyzed and the car is paid for on the basis of this analysis. On the last twenty-five cars delivered Dayton has paid a premium on twenty-two cars and deducted a penalty on three. The cost of sampling and analysis is 2 cents per ton. In the waterworks pumping station alone, where in former times 275 to 290 gal. of water were pumped per pound of coal, it is now possible to pump 375 to 390 gal. per pound, a saving of over 30 per cent, due to a certain extent, at least, to the quality of coal burned. The average analysis of twenty-five cars received since July 1, when shipments on the present contract began, has been over 14,200 B.t.u. and the ash about 5 per cent.

### CITY STOREHOUSE A SUCCESS

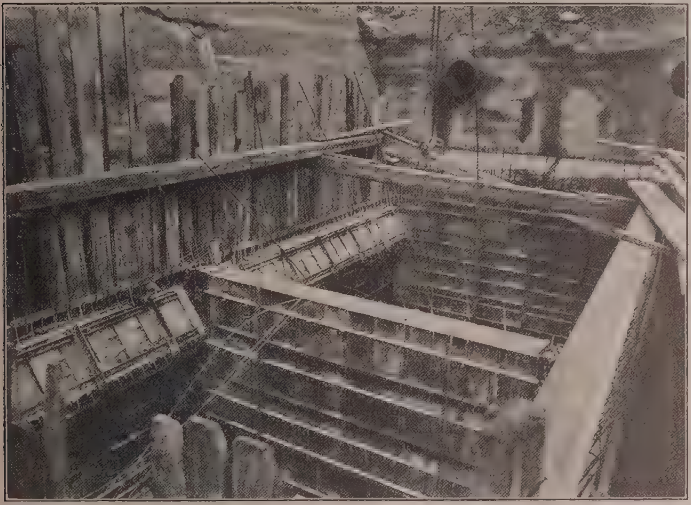
One of the very important changes made has been the establishing of a city storehouse. There are in all cities any number of articles which are used by several departments. Usually the quantity used by any one department is not enough to get the lowest price, but by combining the purchases each one has the advantage of the other's usage.

The city of Dayton has a stores fund from which are purchased such items as can be moved quickly and then sold direct to departments, turning the money back into the stores fund. The percentages saved on items handled in this way run from 40 to 80 per cent and the total amount saved in a year will pay the cost of the storeroom many times over. Besides this the city can give quicker service than if it had to go outside and buy each item. Just a few examples of the large savings in this way are carbon paper reduced from $3.50 to 65 cents per box; typewriter ribbons from 75 to 25 cents each; typewriter paper fom $1.25 to 54 cents per box; rubber bands from $4 to $1.35 per pound, and paper clips from $1 to 25 cents a thousand. This stock room has a complete system and takes care of a great many of the little orders which would otherwise be very hard and slow to handle. It also carries cement, hay, oats, and other more important items, bought when the market is advantageous and held in stores until required.

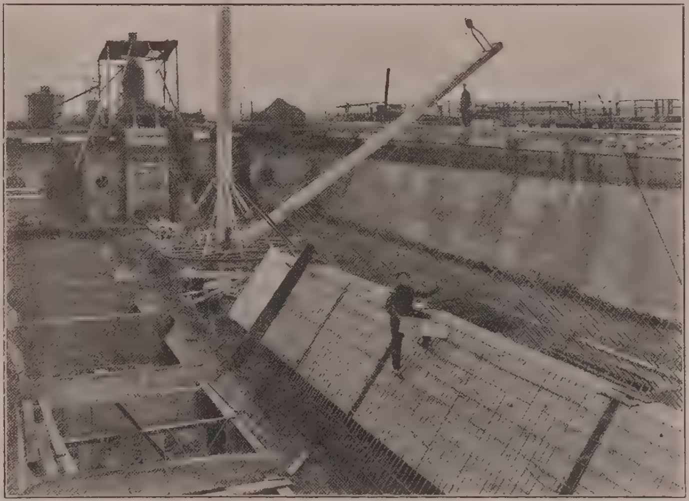
## Columbus Changes Sewage Tanks to Imhoff Type

Standard Light Steel Wall Forms Used in the Work of Reconstruction—Walls of Old Tanks Retained

WITHOUT causing a complete shutdown at the Columbus sewage treatment plant the original settling tanks are being converted into Imhoff tanks by the use of light steel wall forms in standard units, supplemented by specials for intersections of surfaces in different planes. While half of the tanks are thus being modified the other half are continued in operation, taking the entire flow of the plant. The outer walls of the original tanks are left in place and are used as the outer walls of the Imhoff tanks. The work, naturally, is being spread through two seasons.



1. FORMS IN PLACE FOR SLUDGE SUMPS



2. SUMPS COMPLETED AND WALL REINFORCEMENT PLACED

The contractor for this work, D. W. McGrath of Columbus, is using Blaw light wall forms for practically all of the new work, excepting the end channels for the admission and outflow of the sewage. The latter are of such variable form as not to permit a sufficient amount of re-use of the forms to justify the employment of steel.

### SUMPS FOR SLUDGE

The first operation consists of excavating below the bottom of the old tanks, and constructing pits with concrete walls and sumps in their bottoms for the collection of the sludge. The forms are set up for one of these pits complete, a height of 8 ft. above the top of the sump. These forms are filled and removed before the wall is carried up higher, being used again on another sump as soon as they are taken away from the first one constructed.

Photo 1 shows the steel forms filled with concrete for the construction of one of these sumps. The system of liners, holding the forms rigidly in position, is well shown, and it will be noted that on the overhanging wall the liners are bent so as to produce a wall of exactly the right profile.

Photo 2 shows the appearance of the work in one of the old tanks when the sumps for the Imhoff tanks in the bottom have been completed, and the wall reinforcing is being placed for the dividing wall between the two Imhoff tanks; for two Imhoff tanks are being built in each one of the old tanks. This photograph shows a wooden form for the under side of the dividing wall, this being found necessary, as it proved impracticable to place the back-fill on such a steep slope in a manner sufficiently secure to make it practical to dispose the concrete direct upon the earth fill. To secure additional strength, provision was made for cross walls through this earth fill at intervals as shown. The wooden forms, of course, are left in place.

In Photo 3 the steel forms are erected ready to receive the concrete for the dividing walls and the upper portion of the cross walls between the sumps. The picture illustrates how each part of the work is duplicated and how the form is stiffened by the liners and special splice plates at the intercepting angles. In this case, also, the form was provided with a bracket at the top so that a platform or walk was cast at the top of the wall at the same time the wall was cast. In placing concrete in this wall the form was first set up to an elevation about on a level with the shoulder of the man shown in the picture, and filled with concrete to that level, after which the rest of the form was set up to the top of the wall and filled.

### HOW FORMS ARE HANDLED

The forms used on this work are, with the exception of the specials provided for the intersections, strictly standard light wall forms, adjustable for use on all plain wall work, where the height poured at any one time does not exceed 10 ft. These forms are attached to the liners before they are erected, and may be shifted either in units 2 ft. wide and 10 ft., 12 ft. or 14 ft. long, as desired, with the horizontal liners attached, or in larger units with the vertical liners attached, in which case it is necessary to employ a derrick to handle the form on account of the weight. The form weighs about the same per square foot of surface as a well made wooden form, but occupies less space and has much greater stiffness.

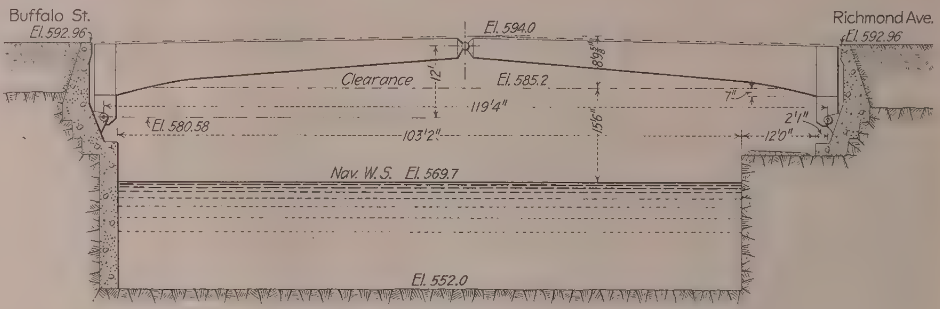
On this particular job the forms used in the sumps were shifted by the derrick in units 12 ft. wide by 8 ft. high or 96 sq. ft. to a unit, similar units being used on the upper sections. In shifting these large units they are picked up by the derrick and swung around into a new place wherever desired, necessitating little handling.

3. FORMS READY TO RECEIVE CONCRETE FOR DIVIDING WALLS

# Three-Hinged Arch Girders with Vertical Ends Provide Barge Canal Clearance

## Main Street Bridge at Lockport Required Special Design Because of Limited Distance from Underclearance Line to Street Grade

UNUSUALLY limited vertical distance from street grade to clearance line resulted in the adoption of a special type of three-hinged arch girder span over the New York Barge Canal locks at Lockport, N. Y. Fortunately the profile of the rock formation at the site was exceptionally favorable to an arch type of structure, because inexpensive abutments to resist the thrusts could easily be constructed. The general method of design of the arch girders and the details of the shop splice at the end joints between the vertical posts and the main girder will be given.



ROCK FOUNDATION WAS VERY FAVORABLE TO ARCH TYPE OF STRUCTURE

### LOCATION AND GENERAL DIMENSIONS

The bridge is located at the intersection of Main Street with Richmond Avenue on one side of the canal and Buffalo Street on the other, the double-track street car line on Main Street running diagonally across the structure. This location is in the center of the business section, and as other streets intersect at this point it was decided to make the bridge unusually wide and use it as a public square. The total width in plan at one end is 307 ft. 6 in., including a triangular corner approach carried by plate girders. A 10½-ft. sidewalk is used on either side of the principal street crossing the bridge, the balance of the floor being finished with 4-in. creosoted planking and 3-in. creosoted paving blocks supported on I-beams connecting the main arch ribs.

The arch girder ribs are spaced at various distances from 7 ft. 6 in. to 13 ft. 6 in. on centers. Span lengths varying from 116 ft. 10 in. to 124 ft. 2 in. between centers of end pins are used, as the width of the canal prism is changing at this point. The clearance of 15 ft. 6 in. above maximum navigable water level required by the State Barge Canal Commission for all overhead bridges on the canal combined with the fixed location of street grades to limit the available distance for total depth of bridge to only 7 ft. 9 in. for these long spans. The unusual form of three-hinged arch girder with vertical ends, as shown in the accompanying typical elevation, was adopted. A slight grade of about 1 ft. up to the center line of the bridge made possible a greater rise of arch to the center hinge.

### ASSUMED LOADS AND ALLOWABLE STRESSES

The design of the floor and arch rib was based on assumed live loads on the trolley tracks as follows: A train composed of cars of 50 tons capacity on either track, each weighing 74 tons when fully loaded, giving axle loads of 37,000 lb. spaced 5 ft. 6 in. apart in trucks 21 ft. 6 in. on centers, the cars assumed 34 ft. on centers; on the second track a train of electric cars weighing 100,000 lb. when fully loaded, and axle loads of 25,000 lb. spaced 5 ft. 6 in. apart in trucks 22 ft. on centers, the cars assumed 40 ft. on centers. The car loads cover 11 ft. in width, and the two tracks are spaced 11 ft. on centers. The balance of the roadway is loaded with 80 lb. per square foot of load.

The allowable stresses used in the design were 20,000 lb. per square inch for tension, and $20,000/[1 + (l/r)^2/18,000]$ for compression. To allow for deterioration due to corrosion of the steel, the sections in the arch girders were increased in thickness about 1/16 in. above the section theoretically required, and 20 per cent was added to the required section modulus of the I-beams in the floor. Impact allowances of about 50 per cent for uniform loads and 95 per cent for train loads were made.

As the span length of the arches varied in the four groups and the position of the tracks loaded with cars varied in relation to

SPECIAL THREE-HINGED ARCH BRIDGE REQUIRED BY SMALL OVERHEAD CLEARANCE

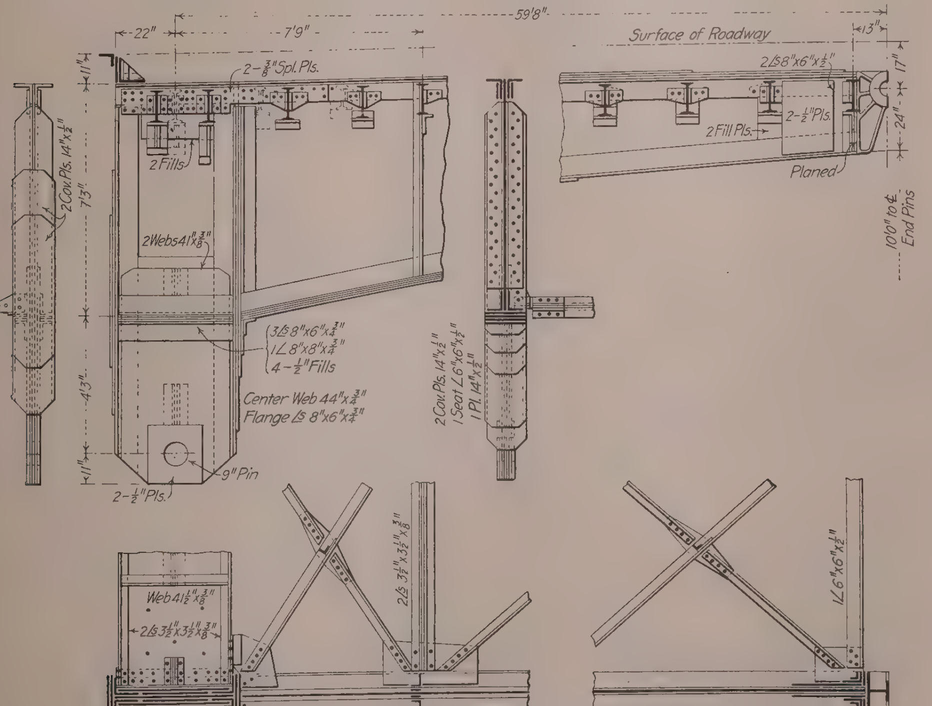
the different arch ribs, it was deemed advisable to construct unit-load influence lines for the stresses in each flange of the arch girders for each of the four groups of the arch spans. This was done by a tabular computation of sections spaced 5 ft. apart. Positions of wheels giving maximum stresses and maximum horizontal thrusts were determined. For uniform loading the area of the influence diagram was used to make the computation of the stress comparatively simple.

### DESIGN OF FLANGES—DETAILS

In general one-sixth of the web plate area was counted as flange area when in compression and one-eighth when in tension. If the stresses in the two flanges were of opposite kind, and one stress was over 50 per cent less than the other, these proportions were increased to one-fourth for the compression flange and three-sixteenths for the tension flange, and if the stresses in both flanges were of the same kind, one-third was used for compression and one-fourth for tension. In all cases the flange stress was computed by moments about the center of gravity of the opposite flange, assumed at 0.15 ft. from the back of the flange angles.

The accompanying detail drawing of the end hinge and shop splice between the vertical end and the main girders shows the material used for the transfer of bending, direct stress and shear. The splice between the web plates is vertical and the heavy compression in the bottom flange of the main girder is transmitted into the end web, reinforced by two 41 x ⅜-in. plates, through the heavy horizontal stiffeners. The end girder strut and lateral bracing in the plane of the bottom flange are indicated in the part sectional plan.

The bridge was designed in the office of the State engineer of New York, under the supervision of W. B. Landreth, special deputy State engineer, by W. R. Davis, chief bridge designer and inspector. The contractor was Larkin & Sangster of Seneca Falls, N. Y., and the total cost was about $1,027,000.



DETAILS OF END HINGE, VERTICAL SHOP SPLICE AND CENTER HINGE

## Wayne County Roads Preserved by Maintenance

### Repair Crew Responsible for Good Condition of 125 Miles of Concrete Highway, According to Annual Report

"WE have over 125 miles of concrete road in Wayne County, Michigan, some of it in its seventh year of service. All of it is in good condition and we have never taken up and replaced a 25-ft. section since we have been building and developing this type of road. This, we think, speaks volumes for our low annual maintenance costs."

This statement is from the ninth annual report of the Board of County Road Commissioners of Wayne County, Michigan, covering the period from Oct. 1, 1914, to Sept. 30, 1915. It would be natural to assume that it would be reinforced with detail figures indicating what the maintenance costs have been, but the reader will search for them in vain. This year's report, like its predecessors, dodges the issue of costs, although a number of pages of lump sum figures are given which are of no practical use, for they are in a form which precludes comparison on a unit basis. The report, however, describes the methods of maintenance used last year, and extracts from this portion of the document are given below.

### TAR TREATMENT FOR CRACKS

A crew of seven men, a team and a tar kettle are used for the maintenance work. The foreman is paid $5 a day, the team and driver $5 a day, tar man $3 a day, two laborers, $2.50 a day each, and two laborers, $2.25 a day each. The tools used consist of several wire bristle brooms, a wheelbarrow, a couple of shovels, a tar bucket and sprinkling cans. Two men are utilized to sweep all cracks or spalled joints clean with the wire brooms, after which the man with the tar can fills the cracks with tar which is heated to about 225 deg. Fahr., allowing it to stand for a few moments to prevent it from bubbling. It is then covered with a clean, coarse, dry sand, spread from a shovel.

Pit holes are similarly treated. An excess of tar and sand is used and traffic is allowed to iron it out. The Wayne County officials use a special tar mixture graded between Tarvia A and X. Where an imperfection exists that does not extend through the road but is over an inch in depth, the practice is to clean it out and dry it carefully, paint it with hot tar, after which it is filled with stone of a suitable size graded to fill the voids as nearly as possible, tamped down or rolled into place. Hot tar is then poured over the patch, the quantity being gaged so that the tar will be taken up by the remaining voids without any large excess being left on the surface, and coarse, dry sand is then spread with a shovel over the surface. Holes of a lesser depth and any joints from which the filler has wholly or partly disappeared come in for the class of treatment already described for cracks and joints.

A maintenance crew will cover from 1 to 3½ miles of road in a day and one trip over the work yearly is usually all that is required. During the past season the maintenance crew had gone over the entire concrete mileage for the year by the middle of August. On Fort, Grand River and Gratiot roads there is a total of about 2 miles of concrete road where the entire surface is covered with a bituminous carpet. This mileage has also been taken care of as during the past. The same grade of Tarvia is used as for other maintenance purposes. Instead of sand, washed and screened pebbles are used. It is necessary to resurface about one-third of this mileage annually in addition to touching up spots here and there throughout the entire season. The method followed has been to sweep the spots to be treated with wire brooms after which the tar is poured. The pebbles are then spread over the tar from barrows or a wagon, and traffic imbeds the pebbles in the tar, forming the wearing surface. The surfaces of these roads become wavy under traffic and are not as desirable as an all-concrete wearing surface either from the standpoint of the comfort of the user or from the standpoint of ultimate cost. A few holes 2 or more inches deep have been repaired by cleaning them out, painting them with a cement grout, and filling the cavity with a concrete mixture of the same proportions as that used in the construction of the original road, the concrete being mixed to the same consistency, as nearly as is possible, as that of the original construction. The repaired portion is cured by being kept wet for at least 7 days and protected from traffic until thoroughly hardened. The Wayne County concrete roads, the report states, possess the special feature of presenting a surface that wears but slightly and uniformly, a surface that does not give way in any one spot and withstands traffic over its entire surface. This is made possible by careful selection of materials, careful methods of proportioning and mixing, and care in finishing and curing, resulting in a concrete having a uniform texture, which is a big factor in eliminating maintenance costs.

### BRICK ROADS CARED FOR

On the brick mileage the cracks which have developed and the bricks that were not too badly chipped are treated in the same manner as the cracks on the concrete roads. It has made a very satisfactory repair, according to the report, and gives promise of adding materially to the life of the brick roads. Broken brick have been replaced from time to time and the roads given an occasional sweeping and cleaning.

It has also been found advisable to use a road scraper to keep the snow leveled down during the winter months, more especially on the roads on which there are street car tracks. The scraper was drawn behind a motor truck and made travel much safer besides distributing it over a wider area of roadway. In fact, every effort is made to keep the roads in proper condition for travel throughout the entire year with a minimum of expense.

It has been deemed advisable to widen out some of the roads to accommodate the largely increased traffic brought about through their improvement. Some of the 12-ft. concrete roads have been increased to from 15 to 18 ft. Crushed limestone was used for this purpose, giving an additional width of macadam of 8 ft.

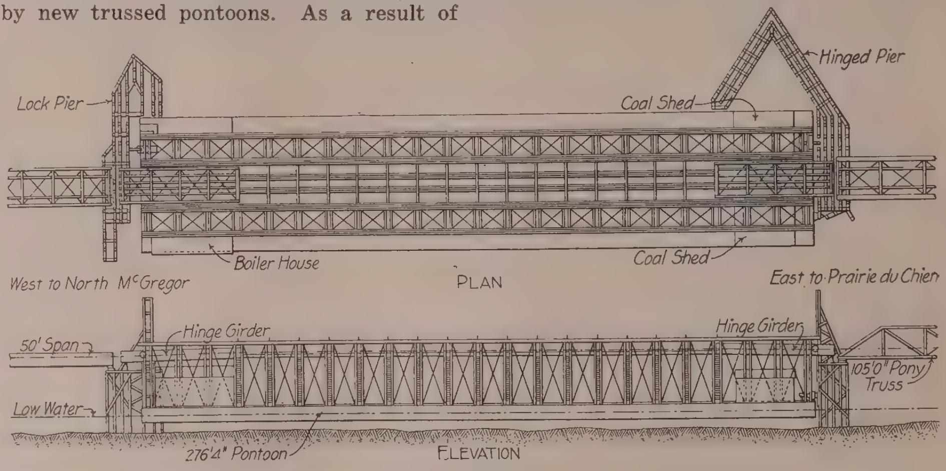
At the end of each construction year all machinery is returned to the sheds at Wayne. Ample space is provided in these sheds for mechanics to overhaul the equipment. A machine shop has been installed and the facilities are at hand to make any practical repair. During the winter months a small force of mechanics and laborers is employed in painting and repairing, and when the equipment is ready for operation in the spring it is always in first-class shape. Nothing is overlooked that will tend to stay depreciation and decay.

The Board of Wayne County Road Commissioners consists of Edward N. Hines, chairman; John S. Haggerty and William F. Butler; the engineers are George A. Dingman and George F. Key.

# Long Pontoon Bridges Carry Heavy Railway Loading—Floor Lifting Devices

### H. J. Hansen Describes Design and Construction Details of Unusual Structure Carrying C. M. & St. P. Railway Over Mississippi River

LONG PONTOON BRIDGES designed to carry railroad loading, used since 1874 at the Mississippi River crossing of the Prairie du Chien division of the Chicago, Milwaukee & St. Paul Railway Company between Prairie du Chien, Wis., and North McGregor, Iowa, are being replaced by new trussed pontoons. As a result of long experience, showing short life of the older types due to excessive deflection, the new pontoons are stiffened by deep trusses as described by H. J. Hansen in a paper recently presented before the Western Society of Engineers. The general methods of design, of swinging the pontoon, of raising the bridge floor and operating the hinge girder spans at the ends are included in the following abstract.



PLAN AND ELEVATION OF PONTOON BRIDGE AND HINGE GIRDER SPANS

### PRESENT PONTOON BRIDGES

About a mile and a half north of this railway crossing the Mississippi River is divided into two navigable channels by an island. The total length of each of the structures bridging the two channels is about 2000 ft. The present bridge across the east channel consists of a 209-ft. 4-in. pontoon flanked by a girder span on the east end and a truss span on the west end, the remaining portion of the track across this channel being carried on a pile trestle. This pontoon was placed in 1914, at which time the U. S. Government allowed a reduction in clear opening from 350 ft. to 160 ft. In addition to the main draw opening, the space under the flanking spans provides a passage for small boats.

The present bridge across the west channel, built in 1900, is composed of a 405-ft. pontoon flanked at each end by a 100-ft. Howe truss span, the remainder of the structure being a pile trestle. This pontoon consists of a scow 405 ft. long, 41 ft. wide at deck level, 36 ft. wide at the bottom and 6 ft. deep. Three longitudinal bulkheads consisting of 8 x 16 and 8 x 12-in. timbers bolted together extend the entire length of the pontoon, the shear between these timbers being transmitted by 2-in. tree nails. The top and bottom joists are 6 x 10-in. timbers, and the sheathing is 3 x 10-in. planks.

### OPERATION AND DIFFICULTIES

This bridge is swung open about 1000 times during a season, which averages about 4.5 openings daily, the greatest number of swings in one week being about 60. The pontoon bridges have given good service with the exception that during high water with heavy wind storms excessive rolling of the pontoons is experienced, sometimes delaying trains for a considerable length of time. Their term of service has also been rather short, it being necessary to renew them about every 15 years. This, to a great extent, is due to the excessive deflection under live loads, which opens up the joints in the sheathing and works out the calking strips, thereby causing excessive leakage and deterioration.

On account of this large deflection and the heavier loading required, the new pontoons are stiffened by four longitudinal trusses, which eliminate this excessive deflection. The actual measured deflection of the new Prairie du Chien pontoon hardly exceeds ½ to ¾ in. for any position of the load, and there can be no doubt that the trussing of these bridges will greatly increase their term of service and reduce the cost of maintaining them.

### NEW PONTOON IN WEST CHANNEL

The new pontoon now being constructed for the west channel to replace the present

405-ft. structure is 276 ft. 4 in. long, 55 ft. wide at the deck, 44 ft. wide at the bottom and 7 ft. 2 in. deep at the center. It is of the same general type as the new east channel pontoon and is designed to carry Cooper's E-50 loading, modified to include only one locomotive. The aim has been to provide adequate stiffness to prevent excessive rocking due to wind and waves, and to provide machinery for operating the floor and end lifts.

The accompanying figures show a general plan of this bridge and the general arrangement of the pulling chain. A part cross-section at typical panel points and a typical half section between panel points are shown. The four longitudinal trusses are proportioned to resist the bending and shear forces in that direction, the inside trusses carrying about two-thirds of the live load and the outside trusses the remaining one-third, the transverse shear between the two being transmitted by the vertical transverse bracing at each panel point.

### DETAILS OF TRUSSES

The web members of the trusses consist of vertical posts and diagonal adjustable rods. The vertical struts are composed of four 8 x 8 or 8 x 10-in. timbers spaced 1 ft. 4 in. apart so as to serve the double purpose of guiding the floorbeams and at the same time act as compression members. The chords are composed of 8 x 16-in. timbers packed and spliced with the railway company's standard Howe truss packing washers and splice clamps, both top and bottom chords being treated alike in this respect on account of the reversal of stress.

The transverse bracing is designed to resist the forces produced in this direction by latching the pontoon at top and bottom to prevent rolling. Web members in both the vertical and horizontal bracing are composed of diagonal timber struts for compression members and upset steel rods for tension members, connected to the trusses with cast-iron angle blocks.

### SCOWS AND FLOOR SYSTEM

The scow is calked on all sides with oakum and calking strips are nailed on the top of the oakum to prevent it from working out. All the timber in the pontoon is creosoted except the sheathing, the oak blocks and the machinery supports. The sheathing is not creosoted, as previous experience shows that the creosoting process, which has a tendency to soften the wood, makes it impossible to obtain a perfect calking seam. It was, therefore, decided to paint the sheathing with Carbolineum after the pontoon is completed instead of creosoting it. On the upstream side the scow is protected against the scouring of ice by ¼-in. steel plates bolted and nailed to the sheathing as shown in the cross-section.

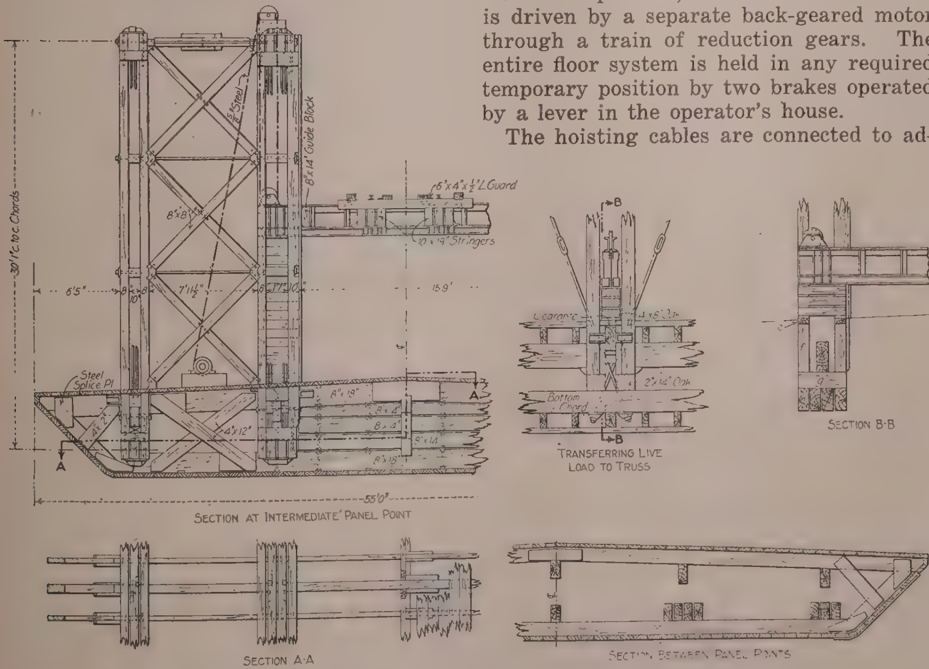
The floor system consists of shallow steel floorbeams and timber stringers connecting up with a 50-ft. hinge span at the third panel point from each end of the pontoon. The floorbeams are supported by blocking piled between the vertical posts of the inside trusses. This blocking rests on the oak bearing blocks, *e*, of the accompanying figure, which transfer the loads to the short strut, *f*, supported on the oak bearing blocks, *g*, of the inside trusses. The track is kept lined up horizontally by timber blocks bolted to the floorbeams and guided by the vertical posts. Vertically the track is regulated by varying the number of supporting blocks under the floorbeams.

### WATER LEVEL VARIATION—RAISING FLOOR

The variation of the water level in the Mississippi River is considerable, the difference between the extreme high and extreme low water being approximately 22 ft. This extreme difference, however, does not occur very often. Provision is therefore made for regulating the track over a range of 16-ft. rise and fall of the river. When the water rises to a higher stage, the approaches have to be raised.

On account of the heavier loading for which this bridge is designed, the floor system is too heavy to be conveniently or economically handled with jacks and, therefore, electrically operated machinery is provided for adjusting the track. The floorbeams are suspended from thirty-four ⅝-in. steel cables winding on thirty-four cast-iron drums. These drums are mounted on two longitudinal drum shafts, one on each side of the pontoon, and each of these shafts is driven by a separate back-geared motor through a train of reduction gears. The entire floor system is held in any required temporary position by two brakes operated by a lever in the operator's house.

The hoisting cables are connected to adjustable eye-bolts at the upper side of the top chords and doubled by leading them through loose sheaves running between brackets connected to the top flanges at each end of the floorbeam. The cables are then led over loose sheaves on the top of the top chord to the drums.



SECTION AT INTERMEDIATE PANEL POINT

TRANSFERRING LIVE LOAD TO TRUSS

SECTION B-B

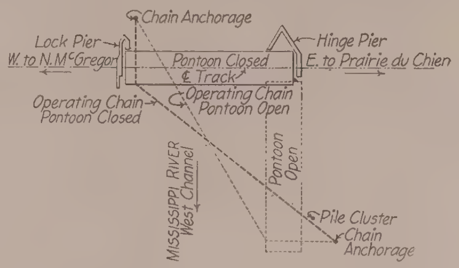
SECTION A-A

SECTION BETWEEN PANEL POINTS

SECTIONS OF 276-FOOT PONTOON—TRANSFER OF LIVE LOAD TO TRUSS

### HINGE SPAN OPERATION

The hinge span is of the through plate-girder type and is suspended from two steel cables, one on each side of the span, by loose sheaves connected to the outside of the girders near the abutment end. These cables then are led over loose sheaves on the top of the top chord to a cast-iron drum located on the deck. This drum is driven with an electric motor through a train of reduction gears.



PONTOON OPERATED BY CHAINS

The electric power for operating the floor lift and end lift machinery is furnished by a 25-kw. generator placed on the pontoon and receiving its supply of steam from the boilers that furnish the steam for swinging the bridge. The swinging machinery, together with the 60-hp. steam engine from the old bridge used for the new installation, is located on the pontoon. The pontoon is rotated about a hinge pile composed of heavy wrought-iron pipe fitted around a wooden pile. The hinge pile is braced to the hinge pier by movable steel straps. The time required to open or close the pontoon 90 deg. is about 5 min., including the time required to lift the girder ends off of the abutments.

### GENERAL METHOD OF DESIGN

The stresses in a pontoon affecting the structure as a whole are produced by unbalanced weight and buoyancy forces. These stresses are transmitted to and carried in the main longitudinal and transverse trusses. In addition to these stresses, the various members may be subject to local stresses caused by concentrated loads on the structure. The local stresses are obtained by the ordinary method employed for stationary structures, and there is nothing new in the theory leading to the main stresses.

The design of the west channel pontoon just described was in direct charge of Mr. Hansen, under the supervision of H. C. Lothholz, engineer of design, and C. F. Loweth, chief engineer of the Chicago, Milwaukee & St. Paul Railway.

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AUTO-TRUCK UPKEEP in the street cleaning department of Springfield, Ohio, according to Charles E. Ashburner, city manager, was $63 last year for a mileage of 12,000 miles with a 2-ton Kelly truck. Allowing for depreciation, wear and tear, he finds that the cost of operation of each truck (Springfield has three), as against the necessary amount of teams to do the same work, is $15 per day in favor of the trucks.

# Literature

## For the Civil Engineer and Contractor

## New Publications

Annual Report of the Water Supply Commission of Pennsylvania, 1914. Cloth, 6 x 9 in.; 399 pages; illustrated. Harrisburg, Pennsylvania Water Supply Commission.

The Gypsum Industry in 1914. By G. F. Loughlin. Part II. Mineral Resources, calendar year 1914, U. S. Geological Survey. Paper; 6 x 9 in.; 9 pages (261-270), illustrated. Washington, Government Printing Office.

Excavating Machinery Used in Land Drainage. By D. L. Yarnell, drainage engineer. Bulletin 300, Office of Public Roads, U. S. Department of Agriculture. Paper, 6 x 9 in.; 39 pages; illustrated. Washington, Government Printing Office.

The Cement Industry in the United States in 1914. By Ernest F. Burchard. Part II, Mineral Resources, calendar year 1914, U. S. Geological Survey. Paper; 6 x 9 in.; 38 pages (221 to 259), illustrated. Washington, Government Printing Office.

Conditions Requiring the Use of Automatic Gages in Obtaining Records of Stream Flow. By C. H. Pierce. Water Supply Paper 375-F, U. S. Geological Survey. Paper; 6 x 9 in.; 8 pages (131 to 139), illustrated. Washington, Government Printing Office.

The Construction of the Panama Canal. By William L. Sibert, brigadier general U. S. A., division engineer, Panama Canal, 1907-1914, and John F. Stevens, chief engineer, 1905-1907. Cloth, 5 x 7½ in.; 338 pages; illustrated. New York, D. Appleton & Company. $2 net.

Stream-Gaging Stations and Publications Relating to Water Resources, 1885-1913. Part XII, North Pacific Slope Drainage Basins. Compiled by B. D. Wood. Water Supply Paper 340-L, U. S. Geological Survey. Paper; 6 x 9 in.; 31 pages (147 to 178), with indexes. Washington, Government Printing Office.

Results of Magnetic Observations Made by the U. S. Coast and Geodetic Survey in 1914. By Daniel L. Hazard, computer, division of terrestrial magnetism. Special publication No. 25, U. S. Coast and Geodetic Survey. Paper; 7½ x 11½ in.; 69 pages, with tables. Washington, Government Printing Office.

Annual Report, Department of Street Cleaning, New York City, for the year 1914. By John T. Fetherston, Commissioner. Paper, 10½ x 6¾ in.; 78 pages; illustrated. New York, Department of Street Cleaning.

Contains statistics and costs of department work, including street cleaning, removal of refuse, and snow removal. In the snow work, emergency men are employed in large numbers as soon as a storm begins and sewers are utilized for disposal.

Imperial Valley and the Salton Sink. By H. T. Cory, civil engineer, with introductory monograph by Prof. W. P. Blake, University of Arizona. Cloth, 6 x 9 in.; 420 pages; illustrated, and containing a large number of maps, diagrams and tabular data. San Francisco, John J. Newbegin. $3.50 net.

A review and history of the region at the head of the Gulf of California, the Colorado River watershed, Colorado River Delta and the Imperial Valley. Irrigation and river control are discussed and a comprehensive account is given of what the reclamation project has done to render productive the fertility of Imperial Valley. A major part of the book is devoted to the reprint of a paper by Mr. Cory before the American Society of Civil Engineers, together with the discussions of the paper that appeared in the Transactions of that society. The author announces it as the purpose of the book to place before the public at large an amplification of the information that developed in the discussion of the original paper.

## Books Reviewed

### Influence of Pile Driving on Ground Conditions

Die Rammwirkung im Erdeich. By Dr.-Ing. Karl Zimmerman, Koeniglicher Regierungsbaumeister. Paper, 10 x 7 in.; 96 pages; 18 illustrations. Berlin, Germany, Wilhelm Ernst & Sohn. $1.50 net (6 marks).

Reviewed by A. G. Hillberg

Civil and Hydraulic Engineer, New York City

It is a well-known fact that driven piling tends to improve the existing condition of the ground by compressing it, and that, in order to get the full benefit, piles should not be driven too close together. It is also well known that the penetration of a pile decreases as the depth increases. Little, however, is known regarding how much the ground is compressed and how far out from the axis of a pile such compression extends. It is equally true that the relation of penetration to blow has been considered in the derivation of all formulas for the bearing power of piles, but it is not generally known that this relation is to a certain extent a function of the size and shape of the pile itself.

In dealing with this subject the author discusses and classifies experiments he has made along these lines. Shape of pile, shape and length of pile shoe, weight of hammer and other variables are analyzed by tables and diagrams.

The last thirty pages of the book sum up the results of the experiments and deal with bearing tests on the piles. It is shown that the bearing power of piles is in direct proportion to the work required in driving them. It is also shown that the error in the existing formulas is too great to permit their use.

The author has dealt with the subject in a very interesting way, and his observations and conclusions deserve the attention of engineers and contractors in the field of foundation work. The publisher has given the book a fitting typographical make-up.

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### Public Utilities—Their Present Value and Return

Author, Hammond V. Hayes, Ph.D., consulting engineer. Cloth, 5¼ x 8½ in.; 207 pages. New York, D. Van Nostrand Company. $2 net.

Reviewed by C. W. Stark

Associate Editor, Engineering Record

This book is founded on the agency theory of regulation. Two points emphasized throughout are that the utility, or undertaking, as the author elects to call it, is entitled to no more than a fair return, and that this return is cumulative from the beginning of the business, so that there is always an attempt to balance the account to date between the public and the utility. The reviewer, believing that the agency theory is neither just, tenable nor expedient, and that cumulative treatment is unfair, both because the records of the past fail to tell the true story, and because the public has no right to date its regulatory measures backward, finds it difficult to appraise the structure the author has built up on these theories.

Chapter 1 is introductory. In chapter 2 the author proceeds to the burden of his argument, that fair present value should be based on what the stockholders have put into plant useful and now in use. He discusses various cases, according as the capitalization is less than both the original and replacement cost, depreciated, is intermediate, or exceeds both. For the last, a special case, he offers no general rules.

For the first type he finds present value to be original cost less depreciation—not a summary of amounts actually spent, covering in part elements no longer in use, but an estimate of what the present useful and used parts ought to have cost. He assumes in this case that reserves for renewals have been earned and allowed to go into new plant.

For the second type he makes original cost new the fair present value. This apparent inconsistency he explains on the ground that if capital exceeds original cost (representing existing plant) it "shows with a certainty that cannot be questioned that users of the past did not pay the full cost to the company of producing the service." He seems to overlook the possible dissipation of earnings in unwarranted dividends. As to the possibility of this higher valuation exceeding the existing plant, he satisfies his conscience by the makeshift of allowing enough appreciation of land to offset the depreciation of plant.

Chapters follow on fair rate of return, replacement cost and actual original cost. As replacement cost, with its so-called unearned increments, is incompatible with the agency theory, the author gives little space to the subject, except to forecast the theme of his chapter on going value. The chapter on actual original cost is of interest primarily because, as previously stated, it interprets the term to mean, not the sum of actual expenditures, but an estimate, applying to the identical inventory used in determining the replacement cost the unit prices prevailing at the time of construction.

Perhaps the best chapter in the book is that on going value. The author argues for a re-allocation of overhead expenses that will result in three distinct groups of cost: Preliminary expenses; cost of physical property, which is stripped to actual cost, engineering, contingencies and contractor's profit; and going value, which is made up of organization, general and legal expenses, taxes and interest during construction. In one respect he is surprisingly liberal. He dates the right of the undertaking to a fair return from the beginning of construction, and on this basis holds that the investors are entitled not merely to interest during construction, but to interest and profit.

The author closes with a chapter on depreciation in which he describes at length the various methods of figuring depreciation, the straight-line method being the one he favors. What he does not explain, what nobody has explained or can explain, is how to determine the length of life of the unit, which is the foundation of all the methods.

To those of the author's faith the work is commended. The theory is clearly presented, and little space is wasted arguing the fundamentals which those of his school will agree are "beyond question." Even those who, like the reviewer, disagree absolutely with those fundamentals can profitably look into the author's interpretation of actual original cost and going value—not to mention the desirability of knowing the viewpoint of the opposition on the whole momentous subject of valuation.

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Drainage Districts in Hillsboro County, Florida, are being actively promoted by the Tampa Board of Trade, which believes that a great part of the future prosperity of the county will be dependent upon the agricultural development of the surrounding country. There is a district of about 30,000 acres north of Plant City, and there are two others of equal size, one north of Seffner and the other north of Thonotosassa. These districts are still in the formative stage and it is uncertain, as yet, as to when construction work on them will be started.

# NEWS OF THE WEEK

## Passing Events in the Civil Engineering and Contracting Fields

### Agreement Reached in Famous Imperial Valley Suit

A settlement has been tentatively agreed upon by the litigants in the case involving the California Development Company and water rights in the Imperial Valley, California, whereby all properties will be taken over and operated by the farmers of the Imperial Irrigation District. The development became insolvent in 1907 and has since been managed by a receiver. Claims against the company totaling about $1,000,000 were entered by the Southern Pacific Railroad and the New Liverpool Salt Works.

The plan of settlement is for these two largest creditors to pool their damage claims, bid in the property at a foreclosure sale and then immediately convey it to the Imperial Irrigation District in exchange for the $1,000,000 in bonds recently voted by the district to buy the property.

One of the provisions of the agreement will be that dredges will be allowed to go into Mexican territory at once to clear the Alamo Canal for next summer's flow. A report presented at the conference showed the California Development Company to be a going concern with $200,000 in the bank and $900,000 in collectible water rates. In thirteen years the business has grown to 380,000 irrigated acres, producing annually crops valued at $16,000,000.

### Iowa Men Form Section of American Waterworks Association

The Iowa section of the American Waterworks Association met for the first time at Iowa City, Dec. 3 and 4. J. H. Dunlap of the State university, issued the call and sent out a program on which are noted twelve papers and a round-table discussion, in addition to the business of ratifying the work of the committee in charge of the formation of the chapter.

### Standard Oil Company Seeking Men for China Service

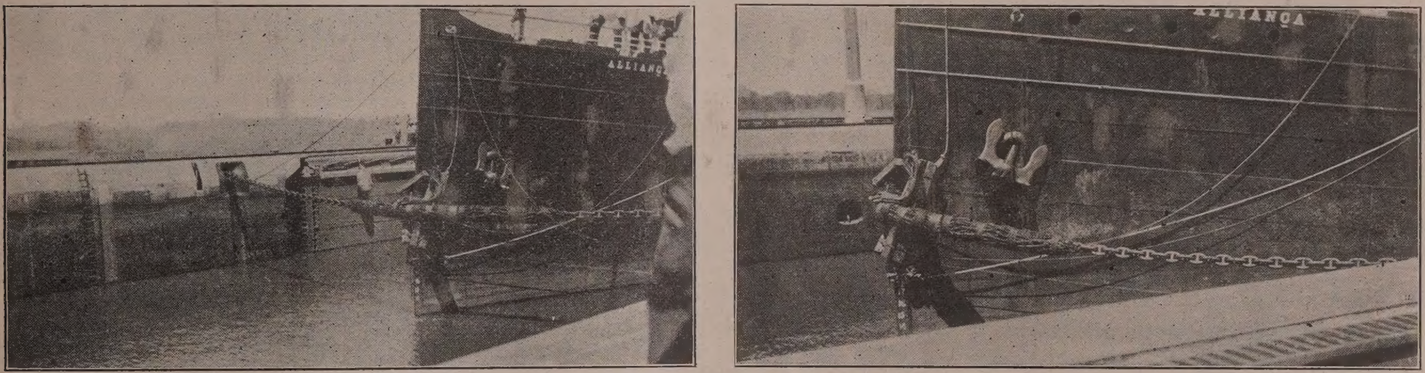
Representatives of the Standard Oil Company held meetings at the University of Illinois for the purpose of interesting students there in foreign service, particularly in China. Those selected for the positions are to be started at an annual salary of $2,000 a year, with a weekly allowance of $17.50 to defray their expenses while attending a training school in New York City.

Information obtained by this journal from the main office of the company, at 26 Broadway, New York City, is to the effect that it is still seeking men for the work, which consists of developing markets. While a knowledge of engineering is not essential, engineers should be well qualified to take up the work on account of their training and experience.

### Fender Chains at Panama Tested by Vessels

On Oct. 26 and again on Nov. 16 the fender chains on the Panama Canal locks were tested by allowing vessels traveling at different speeds to run against them. The tests were made on Oct. 26 with the Allianca, and the position of the chain and vessel when the latter was stopped in two of the tests is shown in the accompanying views.

As a result of these tests with the Allianca, certain changes were made in the fender machinery, and on Nov. 16 the Cristobal, laden with most of her cargo from New York, was run against the chain. No data regarding the results of the tests are available, but presumably, lacking reports of difficulties, were satisfactory.



ALLIANCA TESTING THE FENDER CHAINS ON ONE OF THE PANAMA LOCKS

Left-hand view shows vessel, which had been traveling at a speed of 1.6 miles per hour, in contact with fender chain. Right-hand view shows vessel brought to stop from speed of 2.8 miles per hour. Deflection of chain at center of lock, 52 feet. Note in both cases rope casing of chain and timber mat on bow, to prevent damage to vessel.

The accompanying views were taken by H. U. Birdseye and were furnished to the Engineering Record through the courtesy of Henry Goldmark, who was in charge of the design and installation of the lock gates and fenders at Panama.

### Work on $1,500,000 Pier at Baltimore Will Be Started at Once

In announcing the placing of contracts for its new $1,500,000 coal pier at Curtis Bay, Baltimore, officials of the Baltimore & Ohio Railroad stated that all work would be started at once, it being expected that the improvement will be ready for operation during the season of 1915. H. S. Kerbaugh, Inc., 6 Church Street, New York City, will construct the bulkhead and pier and do the dredging. The contract for grading was awarded to the Smith-McCormick Company, Northampton Bank Building, Easton, Pa. The pier will have a capacity of 10,000,000 tons per year, and is said to be the largest structure of its kind ever planned.

### To Retain Engineers to Advise on Sealing Cedar River Reservoir

A. H. Dimock, city engineer of Seattle, has been authorized to retain engineers to advise with him on the sealing of Cedar Rapids Reservoir. An appropriation of $3,000 was made to pay for such assistance.

### Committee Declares Electrification of Chicago Terminals Financially Impracticable

Commerce Association's Engineers After Four-Years' Study Give Minimum Cost as One Hundred Seventy-Eight Million Dollars

The complete electrification of the Chicago railroad terminals as a means of abating smoke is technically practical but financially impractical. This is the finding of the Chicago Association of Commerce Committee of Investigation on Smoke Abatement and Electrification of Railway Terminals, which has been studying the problem since early in 1911. The committee, in addition, holds that the elimination alone of the steam locomotive would produce a hardly perceptible betterment of the Chicago atmosphere, and urges the appointment of a permanent Municipal Pure Air Commission, which, through both instruction and coercion, would reduce all sources of air pollution to a minimum.

The association committee, as a result of its investigations, reaches the following conclusions:

That the minimum cost of electrification as a means in smoke abatement would be $178,127,230.

That the more probable cost, due to the necessity for improvements and rearrangements, which would be precipitated by electrification, would be $274,440,630.

That the least net annual operating deficit produced by electrification would be $14,609,743.

That Chicago, under the state constitution, cannot aid in meeting this expense.

That an arbitrary tax on terminal traffic to support the capital for electrification would constitute a burden upon the business interests of Chicago.

That the cost would be so heavy that no court would uphold an electrification ordinance.

That the Chicago electrification would equal the combined electrifications of the whole world, would involve problems never heretofore met, and would be the first ever undertaken for air betterment where terminals were adequate from an operating viewpoint.

That before the steam locomotive is eliminated pollution must first be reduced to a minimum from the three more damaging services, high pressure steam plants, metallurgical and other manufacturing furnaces and domestic fires.

That the steam locomotive stands third among smoke producing services, using but

12 per cent of the fuel consumed, and that its elimination would reduce the gaseous pollution of the air only 5 per cent and the solid pollution less than 4 per cent.

That electrification, hydroelectric and other long-distance transmission being inapplicable, would add power-house smoke in quantities sufficient to offset much of the gain through elimination of locomotive smoke.

That suburban passenger services, such as those of the Illinois Central and other roads, produce but 1.54 per cent of the total visible smoke, and 1.97 per cent of all the dust and cinders.

That electrification will involve at least 3476.4 miles of track.

That electrification would subtract only 1,291,282 tons of coal from the total of 21,208,886 tons now consumed annually.

That all smoke regulation in Chicago and elsewhere has erred in confining itself to the visible aspects of smoke, whereas the really harmful factors are the invisible gases and the solids of combustion, sulphurous gas and mineral dust in particular.

That Chicago air is polluted annually by the introduction of 304,391 tons of soot, dust and cinders and of 5,008,111,106,758 cu. ft. of sulphurous and other gases.

That, despite the fact that Chicago burns more coal annually than any other large city—eight tons per capita as against four for Manchester and one and one-half for Berlin—its air is better than that of most large cities.

That Chicago air has the benefit of better sun, wind and rain conditions than that of most other cities.

That the loop is the smokiest district, with the stock yards and South Chicago a close second and third.

That, in Chicago air, the products of combustion constitute only two-thirds the total pollution, the other third being due to avoidable and unavoidable dirt from the general activities of the city and from poor municipal housekeeping.

## Mexican Government Contemplates Early Construction of Railways

The early construction of a large mileage of railways in Mexico is contemplated by the Carranza government, according to statements given out by Rafael E. Musquiz, inspector of that country's consulates in this country. The most important construction planned is a 500-mile line from Nuevo Laredo to Piedras Negras, along the Rio Grande, and thence to a connection with the Matamoras-Monterey division of the national railways. A 450-mile road from Monclova to the City of Chihuahua, which will traverse a region said to be rich in coal deposits and valuable minerals, is also proposed. Construction is to be resumed very soon on the Tampico to the City of Mexico cut-off, which was being built when the revolutionary troubles commenced.

## New $2,500,000 Thames River Bridge for New Haven Road

The old Thames River bridge of the New York, New Haven & Hartford Railroad Company at New London, Conn., built in 1888, is to be replaced by a modern structure, which will ultimately carry four tracks. The new bridge and approaches, located about 185 ft. upstream from the present bridge, will cost approximately $2,500,000. It will consist of five spans, one a lift span of the Bascule type, electrically operated, designed to carry the heaviest loading now known to Eastern railway managers or contemplated in the future. The length of the spans will be, from east to west, 185 ft., 330 ft., 212 ft. and two 330 ft., with approaches 1300 ft. long on the west and 1600 ft. long on the east end. About 5000 tons of steel will be required. The superstructure is to be built for two tracks at the present time, but with a substructure to accommodate a future four-track bridge.

The end abutments will be of reinforced concrete, and the four piers must be carried down from 75 to 142 ft. to reach suitable bearing strata. The piers will be of concrete, faced with masonry between high and low water, three constructed by the open well dredging process and one by a pneumatic caisson. The extreme dimensions are about 42 x 98 ft., and about 48,000 cu. yd. of concrete will be required to construct all the piers.

The plans were worked up by the engineering department of the New Haven road under the supervision of Edward Gagel, chief engineer; I. D. Waterman, construction engineer, and W. H. Moore, bridge engineer. The engineers consulted in regard to the design were: E. A. McHenry, Gustav Lindenthal, J. T. Snow and Ralph Modjeski. The old bridge is to be given by the New Haven road to the State of Connecticut for use as a highway bridge.

## Corps in Field to Monument New Jersey Ship Canal

An engineer corps to monument the center line of the proposed New Jersey Ship Canal has been placed in the field by the New Jersey Board of Commerce and Navigation. The canal is to extend from Bordentown, on the Delaware River, to Morgan, on Raritan Bay, a distance of about 33 miles. The type of canal has not been decided upon, but the plan proposed by the special board of army engineers contemplates a sea-level canal 25 ft. deep, with a 125-ft. bottom width, estimated to cost $45,000,000. B. F. Crosson, Jr., is chief engineer of the Board of Commerce and Navigation.

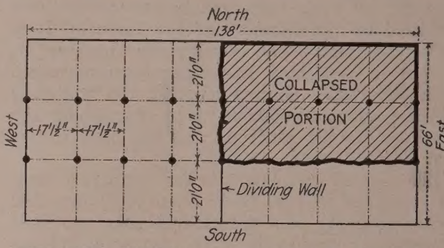
## $51,300,000 Needed for Jersey Road System

In his latest annual report Col. E. A. Stevens, state road commissioner of New Jersey, estimates that $51,300,000 is needed to place the highways of the State in proper condition. "We must put on the job," said Colonel Stevens, "a body of experts, give them the power to get results and judge them thereby. We cannot afford any amateur trifling in our engineering nor any political interference in the administration of our roads. No legislation will satisfactorily solve our difficulties which ignores these principles."

## Frozen Concrete and Weak Supports Wreck Building

### Two Floors of Stanhouse Structure in Rockford. Ill., Collapse—Slender Form Posts Bend Under Load

Frozen concrete and form supports of 2 x 4-in. scantling, spliced in pairs and pieces and so slender that they were bent out of a vertical line by the load they carried, are believed to have been the cause of the collapse of two floors of the Stanhouse Building at Rockford, Ill., Nov. 19. Two laborers, who were removing the forms and had been at work only about 1½ hr. were killed by the falling débris. The wrecked structure was examined, shortly after the accident, by Ernest McCullough, consulting engineer of Chicago, and the following are extracts from his findings:

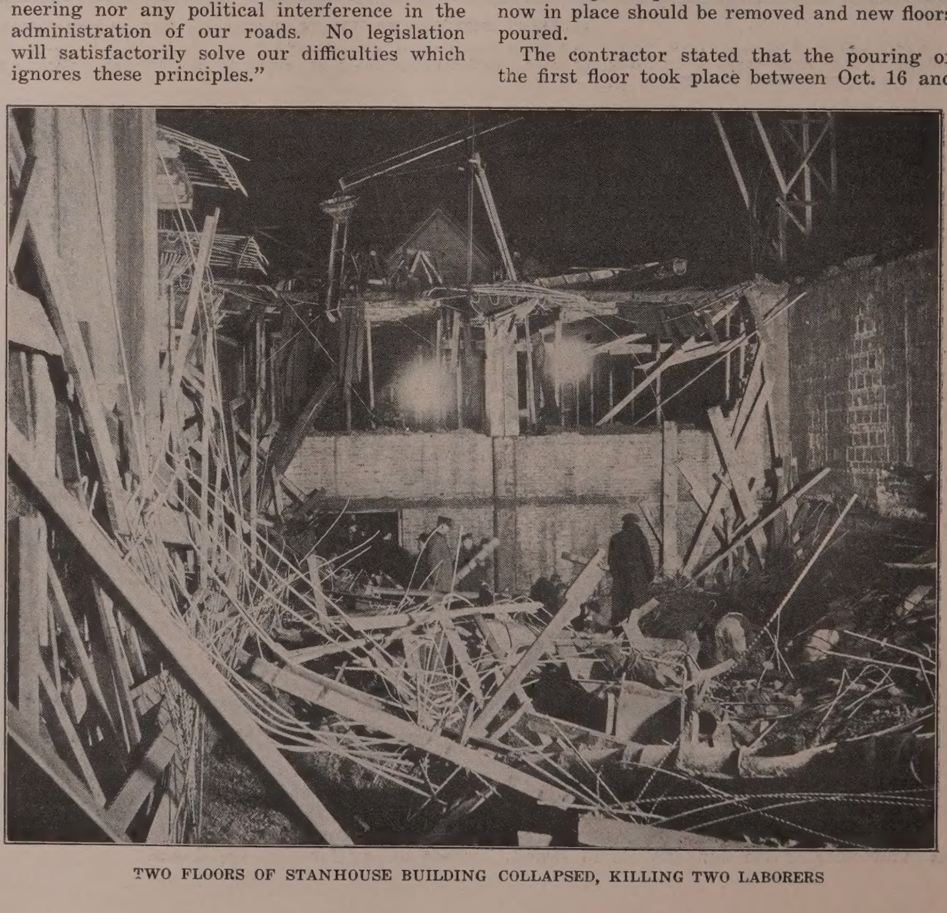


COLLAPSED PORTION OF STANHOUSE BUILDING

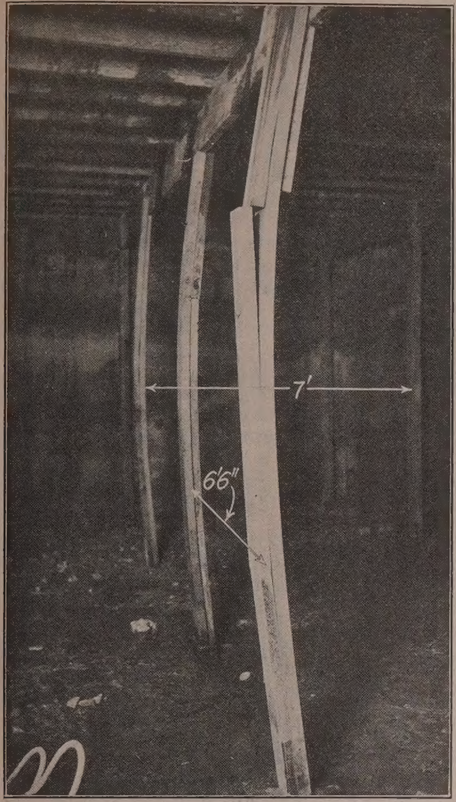
**Ernest McCullough's Findings**

The concrete from the second floor was not set and appeared to contain considerable frost. It lay all over the basement, most of it in as loose a state as the original materials of which it was composed. The steel was all clean, showing that the bond could not have been good. This seemed to be characteristic in many places of the steel stripped from the concrete on the first floor as well as that on the ruined second floor. Even the best of the concrete appeared to have been very greatly slowed up in setting and probably contained considerable frost. If this is the case, then the bond between the concrete and steel cannot be good anywhere in the building. Mr. McCullough's opinion is that all the floors now in place should be removed and new floors poured.

The contractor stated that the pouring of the first floor took place between Oct. 16 and



TWO FLOORS OF STANHOUSE BUILDING COLLAPSED, KILLING TWO LABORERS



FORM POSTS OF SPLICED 2 x 4-INCH SCANTLING WERE SO SLENDER THAT THEY WERE BENT OUT OF VERTICAL LINE

21, so at the time of the failure it was about one month old.

The sand, gravel and water should have been warmed, Mr. McCullough believes, and the building should have been inclosed with some form of artificial heat applied under the floor. The contractor stated that he warmed his sand, but did not warm the water or gravel and did not think the temperature was low enough to call for artificial heating of the structure during or after the pouring, nor for any extraordinary precautions. He evidently poured his concrete in the manner he would have poured it in good weather, except for the heating of the sand.

### Concrete Was Frozen

Two pieces of concrete about the size of a man's fist, or slightly larger, were broken out of the edge of the first floor, still in place, and placed in a bucket of hot water. Before placing in the bucket an attempt was made to break them by striking on some steel bars. It was very difficult to break the pieces in this way, but they appeared moist to the eye and felt moist, or damp. After immersion in the hot water for three or four minutes it was a very easy matter to break them to pieces in the fingers, the edges sloughing off in the water. This test, according to Mr. McCullough, makes it apparent that the concrete was not fully set and that it contained considerable frost, or was frozen before it had set hard.

### Form Supports Faulty

At the time of the failure the first floor had not strength enough to carry its own weight without the assistance of the forms and centering, and when the second floor was poured the additional weight had to be carried entirely by the supports under the first floor. The reason for the failure in Mr. McCullough's opinion, was the faulty form supports. In some cases the supports were 4 x 4-in. posts, but the majority consisted of 4 x 4-in. pieces made by nailing together two pieces of 2 x 4-in. stuff. A great many of these supports are spliced. That is, one piece is full length and the other half consists of several pieces, some two, some three and some four.

In the front of the building, under the portion of floor still standing, cross plank are nailed in two directions to the uprights, thus bracing them in two directions. The bracing is all horizontal, and none is at an angle. Not all of the uprights, however, have this cross bracing. The contractor claims that some of that now standing without cross bracing was braced at one time, but the braces had been removed. The uprights were examined for marks of nail holes to indicate that bracing had been used, but only a few were found, not enough to lead to the belief that even one-half of the uprights now standing had ever been braced. In the rear of the building all the uprights under the first floor are still in place and there are no cross braces there.

In the examination made, Mr. McCullough failed to find one perfectly upright support. All the 4 x 4-in. solid pieces were straight, but they were slanting. Every built up support is bent and those which are braced have two curves in them, in one direction in the lower half below the brace and one in the opposite direction above the brace. The unbraced pieces have very decided curves. One bulged over 6 in. at a height of 5 ft. above the floor.

It is believed that all the uprights started to bend when the concrete was poured and they continued to bend until the concrete set enough to relieve them of part of the load imposed on them. This bending was constantly taking place during the setting of the concrete, until it was wholly stopped on account of low temperatures and moisture conditions. Because of this movement the steel was all the time slowly moving and, therefore, there is no proper bond between the concrete and steel. For this reason, Mr. McCullough believes, all the floors are now unsafe and should be torn out.

## Idaho Changes Policy Regarding Opening of Irrigation Projects

Irrigation projects will not be permitted to be opened in Idaho hereafter until the irrigation company having charge of the construction of the canal and reservoir system has water actually ready for delivery. This stand was taken by the State Land Board, in approving the contract for the Wickahoney Land & Irrigation Company, which will reclaim 30,000 acres of land in Bruneau County. Promoting companies in Idaho in the past have been permitted to sell water rights, before the water was available for delivery and, in some cases, permitted the settlers to occupy the land before the canals were built. The board also decided to supervise the construction of canals and to see that the systems are constructed according to the contract terms.

## Washington Society of Engineers Celebrates Its Tenth Anniversary

The Washington Society of Engineers celebrated its tenth anniversary at a dinner held in Washington, D. C., Nov. 23. G. R. Putnam, commissioner of lighthouses, the president of the society, acted as toastmaster. Among the speakers were: Josephus Daniels, Secretary of the Navy; W. L. Saunders, president of the American Institute of Mining Engineers and vice-chairman of the Naval Advisory Board; Gano Dunn, consulting engineer and past-president of the American Institute of Electrical Engineers, and Arthur P. Davis, chief engineer and director of the U. S. Reclamation Service.

## To Build New Type of Gravel Road on Lincoln Highway in Iowa

A new type of gravel road, recommended by the State Highway Commission, will be put in on the Lincoln Highway, west of Jefferson, Iowa. The first course of gravel will be laid 8 ft. wide in a shallow trench in the center of the roadway, using 600 loads of gravel to the mile. This will be rolled and a second course of gravel spread, and likewise rolled.

## Three Engineers to Study Chicago Transportation

A new study of the Chicago transportation problem on a unified basis, including subways, is to be undertaken by three engineers if the recommendations of the local transportation committee of the City Council are adopted. One of the engineers is to be from Chicago and the other two must be familiar with the transportation problems of New York, Philadelphia and Boston. The investigation is to be financed from the city traction fund and is to be completed by March 1, 1916. That the report is to be a real step to solve the problem is evidenced by the co-operation of the surface and elevated officials.

## South Carolina Drainage Levy Held to Be an Assessment, Not a Tax

In a decision handed down at St. Matthews, S. C., Judge Prince of the lower court held that the levy on property owners for drainage work was not equivalent to establishing and increasing the bonded debt of communities in which it might operate in a manner which was contrary to the constitution. It is not a tax, but an assessment. The law is invoked in a way similar to the law which allows levies upon abutting owners on streets in towns and cities where the required number of holders have subscribed to the petition. The suit was a friendly one and will be referred to the supreme court for a final judgment.

## News of Engineering Societies

**The Associated Engineering Societies of St. Louis** held a joint meeting in that city, Dec. 1, to hear H. F. Hackedorn, president of the Hackedorn Construction Company of Indianapolis, and of the American Society of Engineering Contractors, on "Equitable Contracts and Specifications."

**The American Society of Civil Engineers** will hold its sixty-third annual meeting in New York City, Jan. 19-20.

**The Washington Association of County Engineers and County Commissioners** will hold its annual convention at North Yakima, Wash., Nov. 30 to Dec. 2.

**The Engineers' Society of Western Pennsylvania** will hear E. C. Brown, chief civil engineer of the Carnegie Steel Company, speak on the "Utilization of Iron and Steel Works Slags" at a meeting in Pittsburgh, Dec. 7.

**The New England Waterworks Association** will hold its December meeting at Hotel Brunswick, Boston, Dec. 8. Papers will be presented on: "Some Waterworks Experiences" by Caleb Mills Saville, chief engineer of the Hartford Waterworks; "The Middleboro, Mass., Reinforced-Concrete Tower" by George A. Sampson, civil engineer, of Boston, and "Causes of Explosions of Domestic Boilers" by William A. Bradford.

**The School of Good Roads**, established at West Virginia University under the 1913 State Legislature, will hold its third annual session at the university, Jan. 11-21, 1916.

**The National Association of Bridge Contractors** will meet in Chicago, Dec. 27 to 30.

**The Oregon Society of Engineers, Portland**, Ore., held a banquet, Nov. 18, at which J. C. Ralston, of Spokane, spoke on "The Broader Duties of the Engineer." The dinner was in the nature of a welcome to the students of the College of Engineering, J. L. Fouilhoux acting in the rôle of a college professor.

**The American Association of State Highway Officials** will meet in Chicago, Dec. 7 and 8, at the LaSalle Hotel. While all but the dinner Tuesday night will be executive sessions, the problems to be discussed by the members, highway commissioners and chief highway engineers, will be road construction, uniform road laws in the different states and government aid for road building. Joseph Hyde Pratt, Chapel Hill, N. C., is secretary.

**The American Association of Engineers** will hold its first convention at the Hotel LaSalle in Chicago, Dec. 10-11. Ways and means of co-operating with other organizations to advance engineering opportunity will constitute an important part of the deliberations. Among the speakers scheduled are: F. H. Newell, professor of civil engineering at the University of Illinois; T. B. Lambert, power engineer of the Chicago Telephone Company; Richard Yates, formerly Governor of Illinois, and J. H. Prior, chief engineer of the Illinois Public Utility Commission.

## Personal Notes

W. B. SAUNDERS, formerly consulting engineer of Minneapolis, and previous to that a member of the field staff of H. M. Byllesby & Company of Chicago, has been appointed engineer for the Railroad and Public Service Commissioners of Montana. Mr. Saunders received his professional education at the University of Wisconsin and first engaged in engineering work on the forces of the Union Pacific Railway in 1901. He served with the Rocky Mountain Bell Telephone from 1903 to 1904, and with the Salt Lake Route for a short period in 1905. From the latter year until 1906 he was engineer and construction supervisor for the Michigan State Telephone Company, leaving that work to become assistant engineer in the U. S. Reclamation Service. He joined the forces of H. M. Byllesby & Company in 1910 and continued with them until 1913, during which time he made numerous large surveys and had charge of the construction of the Blue Earth dam and power plant near Mankato, Minn., and of similar work at Coons Rapids, near Minneapolis. He opened offices to engage in consulting practice in the latter city in 1914.

R. M. MORTON has been appointed engineer for the Sacramento County (Cal.) Highway Commission by the board of supervisors.

C. H. BRYSON, city engineer of Lima, Ohio, is in Los Angeles, Cal., on a four months' leave of absence. J. F. Cupp will serve as acting city engineer of Lima until his return.

W. R. HOLWAY, formerly connected with the Rhode Island Company, has been appointed to a position on the forces of the Providence Water Supply Board.

EDWARD GILLETTE, consulting engineer, of Sheridan, Wyo., has been appointed chairman of the board of review of the northern division of the U. S. Reclamation Service. He was graduated from Sheffield Scientific School, Yale University, in 1876 and was engaged for the next four years on the coast survey and the geographical surveys west of the hundredth meridian for the U. S. Government. From this work he went to the Rio Grande Western Railway, where he worked as locating engineer and chief draftsman for a similar period. During the following ten years he was locating engineer for the Chicago, Burlington & Quincy, with which company he also served six years as superintendent. He was superintendent of water division 2 in Wyoming for four years and engineer in charge of railroad location surveys for the U. S. Government in Alaska for one year. Following this he served for a four-year term as state treasurer of Wyoming, and, since 1911, has been engaged in consulting practice at Sheridan. In his new office it will be his duty to recommend the proper charges for the Government to collect from settlers on reclamation projects for water. This will necessitate examinations of the costs of engineering works, operation, maintenance of canals and the distribution of water, also the value of soil products, improvements and general conditions relating to the settler's business and financial condition.

H. E. BARTLETT, assistant engineer of the smoke abatement and electrification committee, Chicago Association of Commerce, for the last four years, has been made first assistant engineer of the Illinois Public Utility Commission. He is one of the early enthusiasts of the American Association of Engineers. From 1906 to 1910 he was in the engineering corps of the Missouri Pacific Railway Company.

T. McLEAN JASPER, captain, 172d Brigade, Royal Field Artillery, writing from the training camp at Aldershot, England, states he has completed his course of instruction. By now he should be on the continent. He was formerly assistant engineer with Alvord & Burdick, consulting engineers, of Chicago, and later was secretary to the Chicago Wastes Commission. His wife is at her home at Treviddo, Liskeard, Cornwall, and letters may be addressed to him through her.

E. L. FULKERSON, secretary of the municipal waterworks of Waco, Tex., will be the administrative head of that department, performing the duties formerly discharged by the late S. J. Quay, superintendent of waterworks. Mr. Fulkerson is secretary of the Southwestern Waterworks Association.

L. A. CANFIELD, formerly deputy county engineer of Skagit County, Washington, has been appointed city engineer of Mount Vernon, Wash., succeeding John Meehan.

LEON L. MOISSEIFF, formerly engineer of design, Department of Bridges, New York City, has opened offices at 69 Wall Street, New York City, to engage in practice as consulting engineer. Mr. Moisseiff was graduated from Columbia University in 1895 and was engaged from then until 1896 with the New York Rapid Transit Railroad Commission. From this work he went to the Dutton Lock & Engineering Company of New York City, for whom he worked principally on the design of lift locks, drydocks, gates and lock improvements for the Erie Canal and the proposed Newark and Cohoes locks for a year and a half. In the latter part of 1897 he was appointed bridge engineer and draftsman in the department of street improvements of the Borough of the Bronx, New York City. He entered the department of bridges of the city in 1898 and continued in that service until recently, being engaged in work in connection with such structures as the Manhattan and Blackwell's Island bridges, over the East River and the Queens approach to the latter structure. He also prepared plans for reconstructing Brooklyn bridge and had charge of plans for the proposed Henry Hudson Memorial bridge, as well as of the design and execution of the work of strengthening the Williamsburg bridge.

CHARLES E. PAUL, professor of mechanics at Armour Institute, Chicago, has been retained as consulting engineer by the National Lumber Manufacturers' Association.

ROBERT J. LOVE and JAMES V. RICHARDS, architect and architectural engineer, respectively, of Chicago, have formed a partnership to be known as Love & Richards, for the practice of architecture in that city. Mr. Love was graduated from the University of Illinois in 1908. Since that time he has been employed by J. C. Llewellyn, Chicago. Mr. Richards was graduated from the University of Illinois in 1910. He has been with J. C. Llewellyn as well as Perkins, Fellows & Hamilton, Chicago.

W. A. CATTELL, consulting engineer of San Francisco, who so successfully filled the office of secretary-treasurer of the International Engineering Congress, has been retained by the Honolulu Rapid Transit and Land Company as a witness in the injunction suit brought by the Territory of Hawaii agaist that company. He will investigate the plant of the company and testify as to the physical valuation and cost of its property.

W. L. SEDDON, assistant to the president of the Seaboard Air Line Railway, and head of the engineering department, has been made vice-president of that company. Mr. Seddon was born in Virginia, and was graduated from the University of Missouri in 1884. His early engineering experience was acquired with the U. S. Engineer Department, with the St. Louis Electric Railway & Power Company and on the St. Louis waterworks. Most of the period from 1890 to 1898 he was in private business. His service with the Seaboard Air Line Railway dates from 1898. In 1901 he was given charge of all construction south of Columbia, S. C. Four years later he was made chief engineer, which office he held until January, 1913, when he was made assistant to the president. Mr. Seddon is a member of the engineering committee of the President's Conference Committee, the organization representing the railroads in the Government valuation work. He is also a member of the committee on yards and terminals of the American Railway Engineering Association.

WYNKOOP KIERSTED, consulting engineer, of Kansas City, is closing his Kansas City office on account of personal interests at Liberty, Mo., which will be his future address.

JOHN A. LOGAN, of the Logan & Gietz Construction Company of Elgin, Ill., has been appointed a member of the Illinois Waterway Commission at a salary of $5,000 per year by Governor Dunne of that State.

DR. H. P. CORSON, formerly chemist and bacteriologist at the University of Illinois, has been appointed sanitary chemist in the U. S. Public Health Service at Grove City, Pa. Dr. Corson received his professional education at New Hampshire College and later took post graduate work at the University of Illinois. He was appointed to his former position in 1911.

W. THOMAS WOOLEY, city engineer of Syracuse, N. Y., has accepted an appointment as city engineer of Schenectady, N. Y., same to take effect Jan. 1, 1916. Previous to becoming city engineer of Syracuse in 1913, Mr. Wooley served for two years as city engineer and architect of Schenectady. Before that he was city engineer of Auburn, N. Y., and engineer of the Public Improvement Commission of Hoosick Falls, N. Y. He was graduated from Rensselaer Polytechnic Institute in 1900.

CLAUDE E. COX, formerly assistant valuation engineer for the Chicago, Milwaukee & St. Paul Railway at Chicago, has been appointed engineer of estimates for the Union Station Company of that city. He entered railway service as a rodman on the Indianapolis & Vincennes division of the Pennsylvania Lines West of Pittsburgh in 1901. In 1904 he was appointed engineer in charge of location and construction for the Duluth, St. Cloud, Glencoe & Mankato, and in 1905 left that service to go to the Chicago, Milwaukee & St. Paul as assistant engineer in the office of the district engineer at Minneapolis. He was appointed assistant valuation engineer in 1912.

ABERTHAW CONSTRUCTION COMPANY, specialists in concrete, of Boston, has moved its offices to the recently erected Niles Building, 27 School Street, Boston.

MORRIS K. TRUMBULL, vice-president of the National Lumber & Creosoting Company, has been placed in charge of a new office of the company recently opened in the Commerce Building, Kansas City, to supplement the offices in Houston, Texarkana and El Paso. Previous to his entry into the lumber and creosoting field, Mr. Trumbull was for two years engineer of track elevation for Chicago, returning to his old company, the Chicago & Western Indiana Railroad Company, as principal assistant engineer in 1910.